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SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS

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Vidicon Light-Transfer Characteristics and Film Reproduction

By R. G. NEUHAUSER

The light-transfer characteristics of the vidicon cannot be used directly to predict light-transfer characteristics of a television-film system. The practice of setting the darkest excursions of the video portion of a TV signal to black level, or cutoff of the TV picture tube, changes the effective light-transfer characteristic of the vidicon. Additional gamma correction of the electrical signal is required to reproduce film properly on television. The type of correction necessary for the proper reproduction of film meeting the new proposed specifications for density range and transfer characteristics of television film is described.

A REVIEW of vidicon light-transfer characteristics and film reproduction has been prompted by the recent efforts of the RP7 Subcommittee of the SMPTE Television Committee to standardize television film-density characteristics. The basic light-transfer characteristics of the vidicon camera tube cannot be used directly to predict the performance of a film-reproduction system because the television video operator inserts a correction into the system in a form of a pedestal or black-level adjustment. The video operator usually sets the black level of the video signal by means of the pedestal control of the vidicon camera; the darkest portions of the picture are set at the composite television-signal black level which is a few per cent above the blanking signal.[1] This operation, which changes the effective light-transfer characteristics of the vidicon, is shown graphically in Figs. 1 through 4.

Curve *A*, Fig. 1, is the basic light-transfer characteristic of the vidicon. On this curve is shown the range of light values projected into the tube and the signal output that can be expected when the film has a density range as specified in the proposed SMPTE standards for motion-picture film for television. The high-light and low-light values correspond to a film density in the high lights of 0.3 and a density in the low lights of 1.9, a contrast range of 40 to 1. The 9:1 ratio of signal current produced between the low lights and the high lights is considered a conservative value because the contrast range of a film image on the vidicon is rarely as high as 40 to 1. A more typical value of the brightness range of the film image on the vidicon faceplate is 20 to 1, owing to light dispersion in the optical system and in the vidicon. In this case, the ratio of high-light to low-light signal current is 5.5:1.

If no correction had been made by the video operator, and if the desired black level had been set initially to correspond to zero light, the television video waveform would be as shown in curve *A* of Fig. 1. Under these conditions, the signal level of the darkest portion of the video information in the scene would be set 18% above the desired black level of 5% as shown in Fig. 2(a). The usual procedure in a TV studio is to lower the black level of the video signal shown in Fig. 2(a) to the black level shown in Fig. 2(b), and then increase the video-amplifier gain until the high-light signal amplitude reaches the 100%

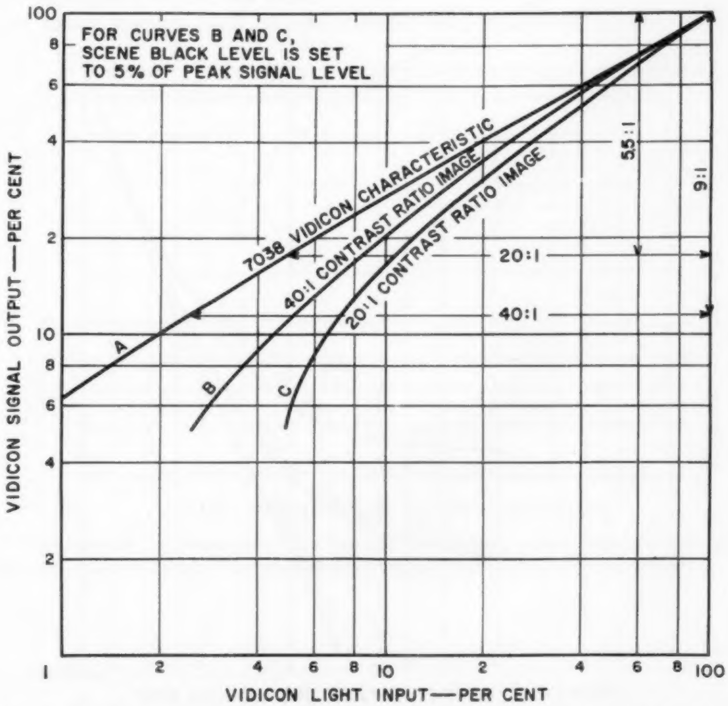

Fig. 1. Actual (curve *A*) and effective (curves *B* and *C*) vidicon light-transfer characteristics.

Presented on May 9, 1961, at the Society's Convention in Toronto by R. G. Neuhauser, Electron Tube Div., Radio Corp. of America, Lancaster, Pa.
(This paper was received on June 20, 1961.)

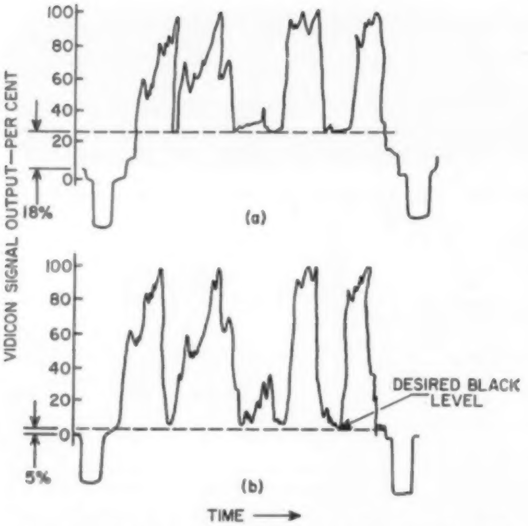

Fig. 2. Video-signal waveforms from vidicon produced by 20:1 contrast-ratio image: (a) black level uncorrected; (b) black level set to 5% video-signal level.

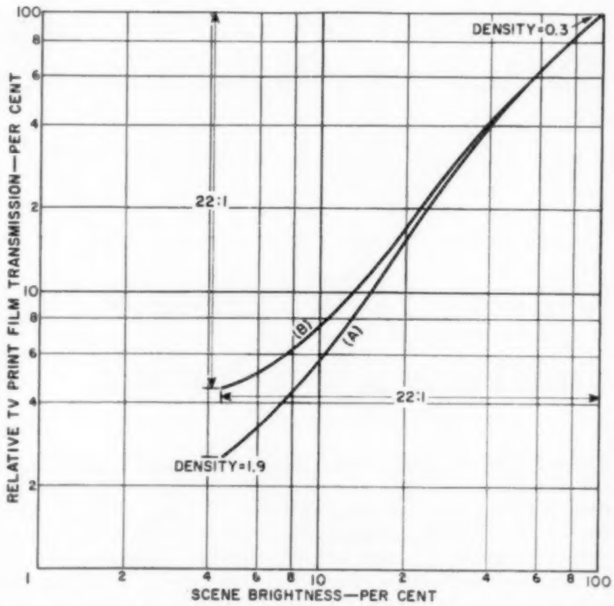

Fig. 3. Curve (*A*) Typical Eastman 7231 and 7302 film "print-through" characteristics processed for TV; curve (*B*) luminance values of film image on vidicon photoconductor with 2% scattered light resulting from the optical system.

level. The net effect of this operation is to change the *effective* gamma characteristic of the vidicon. The effective light-transfer characteristic shown in Fig. 1, curve *C*, results from subtraction of the d-c component to produce an artificial black level. This new light-transfer characteristic determines the function of the vidicon in the overall television film-reproduction system.

Determination of Proper Camera Gamma Correction Amplifier Characteristics

The black-level setting operation produces a higher gamma characteristic for the vidicon, as shown in Fig. 1, curve *C*. The *basic* gamma characteristic of the vidicon was approximately 0.60 and was constant over a wide range of light levels or a wide range of signal output levels. The average gamma under the conditions shown for curve *C* of Fig. 1 for a signal output range of 10 to 1 is 0.78 and varies from a value of 0.73 at the high lights to a value of 3.3 at the low lights.

The gamma-correction amplifier characteristics which will be required can be determined by using a typical television film process print-through characteristic, the television picture-tube characteristics and the "new" vidicon light-transfer characteristic derived in Fig. 1, curve *C*.

Figure 3 shows a typical film characteristic of a carefully made television film that conforms to the new proposed recommended standards of television film practice.* This characteristic is expressed in terms of transmission and initial scene brightness. Figure 4 shows the characteristics of a typical black-and-white picture tube; the three curves represent the brightness values of the picture tube with various amounts of stray light on the tube. Although figures on the amount of stray light on a typical TV receiver picture tube are only estimates, if the effects of stray secondary electrons, faceplate and implosion panel dust, children's fingerprints and room light are taken into consideration, the 5% stray-light curve is not unreasonable.

Because neither the picture tubes, the vidicon nor the film characteristic is a simple mathematical function, a graphical or a tabular method is the most simple

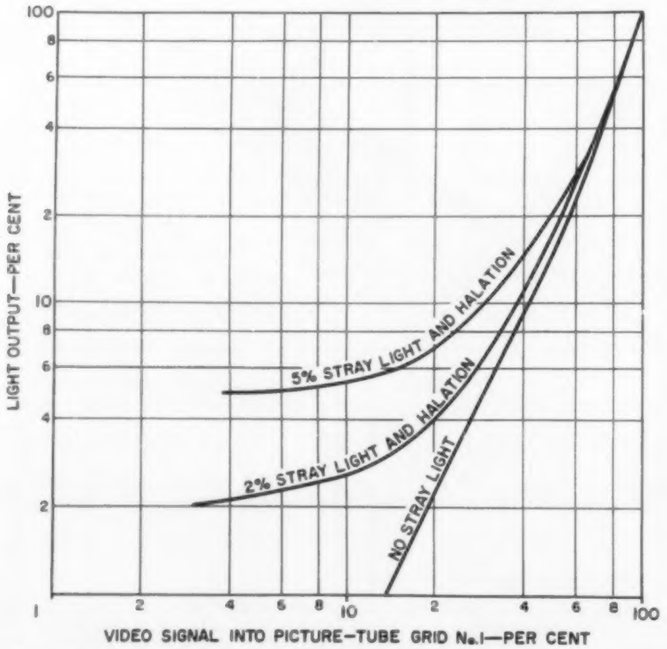

Fig. 4. Picture-tube brightness as a function of grid No. 1 drive showing effects of stray light and halation.

* This curve was supplied by engineers of the Canadian Broadcasting Corp. who have done an excellent job in studying the problem of film requirements for television and setting up workable standards of practice for film shooting and processing.[2,3]

means of determining the amplifier gamma requirements. The vidicon does not have a light-signal characteristic which will exactly compensate for film and picture-tube characteristics.[4,5] The characteristic of an amplifier designed to provide the additional correction must be determined by working for both ends of the system and making the following assumptions:

(1) Film characteristics are as shown in Fig. 3. These characteristics are typical of a carefully controlled exposure and print of Eastman 7231 negative film and Eastman 7302 positive film.

(2) The picture tube has between 2 and 5% stray light on the faceplate. (Curves developed for either case.)

(3) Stray light on the vidicon photoconductor has a value of 2% and results from internal reflections and light dispersion in the vidicon and photoconductor, as well as light dispersion in the lens and optical multiplex system.

(4) Black level (darkest picture information) is set to 5 video units on the IRE scale of the television-signal level (5% video-signal level).

(5) Scene elements representing exposure densities between 0.3 and 1.9 print density are reproduced in the same per cent brightness as they were in the original scene. In both cases 100% scene-brightness level corresponds to the 0.3 ND film density.

The three curves of Fig. 5 are constructed from the characteristics of Figs. 1 3 and 4: the vidicon characteristics, the film density characteristic and the picture-tube characteristic, respectively (see Appendix, Table I). These curves are understandably different in the low-light level although they are similar in shape. An unusual feature is the reverse curve in the upper range, which is necessary to compensate for the upper knee of the film characteristic. This compensation keeps facial tones and other bright objects from becoming "squashed." Squashing of the highlights causes detail to be washed out in highlights at the expense of getting good tonal values in the low lights of the picture. O. H. Schade has pointed out the need for this type of characteristic in his classic paper on image gradation and sharpness in motion pictures and television.[6] Figure 6 shows ideal camera-tube characteristics that would require no additional gamma characteristics; however, at present this characteristic cannot be produced in a vidicon.

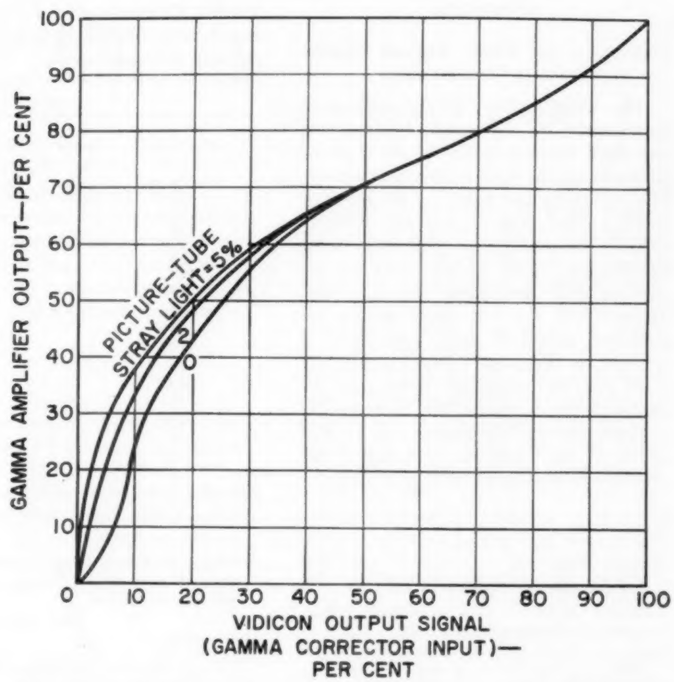

Fig. 5. Suggested characteristics of the gamma-corrector amplifier for proper reproduction of "typical" film produced for television. The curves represent different amounts of stray light assumed to be present on the picture-tube faceplate. Scene blacks are set to 5% video level, and the film image produces a 20:1 contrast ratio from film image on the photoconductor of a 7038 vidicon.

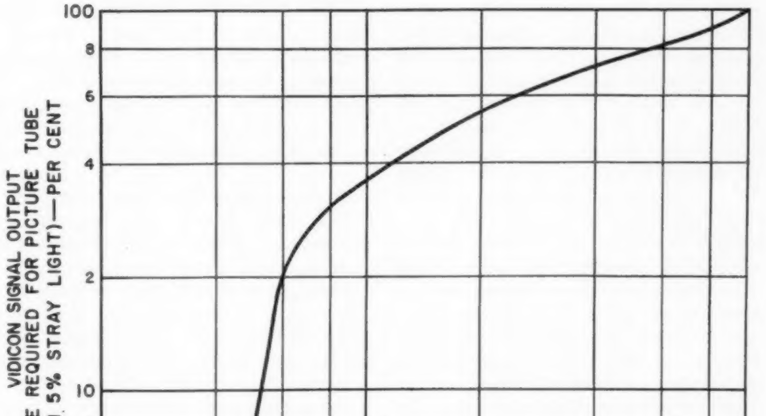

Fig. 6. Light-transfer characteristics of a hypothetical vidicon which would require no gamma correction for proper reproduction of typical film processed for television.

(*See following page for Appendix.*)

APPENDIX

Derivation of Basic Vidicon Light-Transfer Characteristics

The signal output of the vidicon is represented by the video signal above the dark current level.[7] In the case of film pickup, the dark current is normally held to a very low value (in the order of 0.005 μ amp). The light-transfer characteristics are derived by uniformly illuminating the proper scanned area on the vidicon and measuring the d-c dark current and the d-c signal ouptut for different values of light. The signal is defined as the total current minus the dark current. Although there may be many other methods for determining vidicon light-transfer characteristics, this method was used to determine the characteristics described in this paper.

Table I. Characteristics of Figs. 1, 3 and 4 Used in Constructing Fig. 5. The curves of Fig. 5 were derived by plotting the values in column (A) against those in columns (B) (C) and (D) respectively.

		(A)	(B)	(C)	(D)	
Original scene brightness, %	Image brightness on vidicon, %*	Vidicon output corrected for black level, %†	Required drive for picture tube, % With stray light‡of 5%	2%	0	Light output, %
100	100	100	100	100	100	100
90	92	96	96	96	96	90
80	83	92	92	92	92	80
70	74	85	88	88	88	70
60	63	77	83	83	83	60
50	52	67	78	78	78	50
40	40	55	73	73	73	40
30	27	39	64	64	64	30
20	17	26	55	54	50	20
15	12	19	50	47	40	15
10	7.8	12	42	37	30	10
8	6.5	10	38	33	24	8
6	5.5	7.4	33	27	12	6
5	4.8	5.2	30	24	6	5

* From Curve *B*, Fig. 3. † From Curve *C*, Fig. 1. ‡ From Fig. 4.

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Discussion

Mark Krivosheev (Radio Institute, Moscow): What is the signal-to-noise ratio of the output of the vidicon?

Mr. Neuhauser: The signal-to-noise ratio in the vidicon tube itself is very high. The signal-to-noise ratio you are normally concerned with is the signal you can get from the vidicon in relationship to the noise in the preamplifier for the vidicon tube. In a vidicon system using a very low-noise amplifier, and with the vidicon producing a peak signal output of about 0.35 microamps, the measured signal-to-noise ratio will be approximately 100 to 1. If you consider the fact that the noise is concentrated in the high end of the frequency band and less noticeable to the eye, the effective signal-to-noise ratio is approximately 300 to 1. Then, if you stretch the blacks to change the gamma characteristics, you increase the effective noise — at least in the low lights — without increasing the signal level. This reduces the signal-to-noise ratio. If you put aperture correction, as we call it, into the system to compensate for loss in high frequencies in the tube this, in turn, boosts the noise — so your signal-to-noise ratio is probably somewhere around 100 to 1 after you have finished putting all the correction factors into the system.

Simulated Night Photography Using Color Reversal Films

By GEORGE T. KEENE

The current methods of obtaining night effects in daylight photography are reviewed critically, and a number of possible improvements are explored. An original given two stops overexposure and printed using a printing master is shown to give a desirable reduction of tone scale, less color saturation, and a more realistic night effect. The required compromise between realism and tone compression is explained. Night scenes photographed using artificial lights and moonlight are discussed briefly.

It is often necessary, especially in dramatic productions, to create a nighttime effect using daytime photography. Such sequences enhance a story line, adding a touch of realism among more routine scenes. The requirement for night scenes is as old as motion pictures and has been met over the years in a variety of ways.

When the main concern was black-and-white photography, simulation of night effects in daytime was usually accomplished by the use of yellow filters and panchromatic film. A filter such as the Kodak Wratten No. 72B or a combination of the Wratten 23A and 56 filters darkened the sky as desired without washing out flesh tones or requiring excessively dark makeup on the actors. Infrared-sensitive film with deep red filters has also been used on marine scenes, but this combination has been less successful ashore not only because face tones were washed out but also because green vegetation was rendered in excessively light tones.

Color films present additional problems. Foremost of these is the bright blue sky obtained in even the best night simulation scenes. By proper choice of camera angle, the sky problems can often be minimized, but frequently the hero must be shown supposedly chasing the villain in darkest night when a sudden pan shot reveals a brilliant, pale blue sky.

Of lesser importance but still annoying is the brilliance and saturation with which colors are reproduced in the usual night scene. Red, green, and yellow objects are ordinarily seen with saturation actually increased over that in a normal print. While some color is undoubtedly desirable in night-scene reproductions, even brilliantly colored objects are not seen at night and are unrealistic when presented on the screen.

In this paper we discuss the difficulties found in current night-simulation techniques, pointing out the sensitometric reasons for these difficulties, and describing a technique for improving on conventional results in certain instances. In arriving at our conclusions, a number of unsuccessful methods were tried; these, too, are described. Finally, there is a discussion of night scenes taken in other than full daylight.

Presented on May 8, 1961, at the Society's Convention in Toronto by George T. Keene, Color Technology Div., Eastman Kodak Co., Kodak Park, Rochester 4, N. Y.

(This paper was received on July 25, 1961).

Current Practice

First, what is meant by night-scene simulation? This work is primarily concerned with exposing in daylight pictures that can later be printed to give the appearance of full moonlight on projection. Here the main source of illumination is the sun, possibly supplemented by reflector fill-in, and with the setting definitely indicating exterior action at night.

Excluded from this definition are night scenes in which the main illumination is from artificial sources, i.e., street lights, neon signs, flames, or other obviously man-made sources. Photography under these conditions will be discussed later on.

The usual procedure in day-for-night photography using reversal films is to remove the Kodak Wratten 85 conversion filter and underexpose two camera stops. This gives an original film which, when printed at the balance for a normal scene, gives a blue, dark print that in many respects provides a good impression of moonlight. The blue overall balance seems to be necessary to satisfy our recollection of moonlight, and the print density obtained is usually close to that desired for night effects. Some density timing is occasionally needed.

When Kodachrome Commercial Film was commonly used for the 16mm reversal original, this procedure gave reasonably good night effects. Sky areas were bright, but otherwise color reproduction was effectively subdued except for very bright red objects. The advent of Ektachrome Commercial Film changed this situation substantially, as its improved, more saturated color reproduction is seen even with 2 stops underexposure. Skies remained bright blue in most cases and all colors were cleaner and more brilliant.

The results obtained on Ektachrome Commercial Film using 2 stops underexposure with no Wratten 85 were shown in a picture demonstration. A print was made on Eastman Reversal Color Print Film, Type 5269 beginning with an interior scene suggesting a night sequence to follow. This "lead-in" footage was necessary for proper evaluations of various night-effect techniques, as it allows time for visual and mental adaptation to a night situation. Most prominent in the outdoor shots were a bright red dress and a deep blue sky in certain scenes. In addition, there were bright highlights and a long tone range to which many viewers would object as being unrealistic in a night scene.

The problem now is well defined: to improve the realism of day-for-night exposures on Ektachrome Commercial Film, a way to reduce color saturation, darken skies, and compress the tone scale must be found. Essentially, black-and-white reproduction must be approached with a color film in full daylight.

Possible Exposure Methods

In searching for a better method, the two-stops-underexposure technique was first extended in a picture series from normal to three stops underexposure. In these scenes the original was exposed without a Wratten 85 to give a blue balance; adjustments from normal balance were made to get uniform color and density in all three prints.

As the original was more and more underexposed, the saturation of colored objects actually increased, a situation exactly contrary to the requirements for night scenes. The scene given three stops underexposure, instead of improving upon current practice, appears to have more color saturation than normal and maximum contrast in the highlights. The reason for this is evident from the data in Fig. 1. The sky brightness range on each original is plotted on the characteristic curve of Ektachrome Commercial Film. As successively more underexposure pushes the sky record further up the curve, the density range for a sky is increased until all sky densities are recorded on the straight-line part of the Ektachrome Commercial curve. Bright colors and highlights get similar treatment with a general increase in lower-scale density range. This action suggests that moving the scene record in the other direction, i.e., overexposure, might give the desired compression of colors and tone scale. This thought will be explored at some length later.

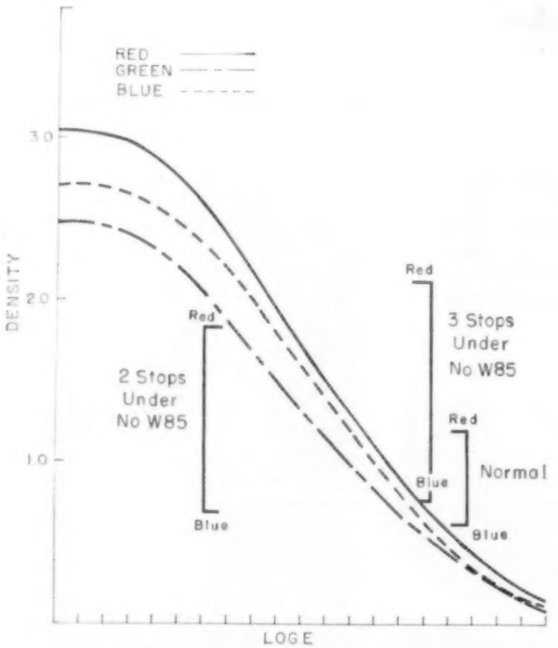

Fig. 1. Range of sky densities as recorded on Ektachrome Commercial Film at three exposure levels: normal, 2 stops underexposure, and 3 stops underexposure.

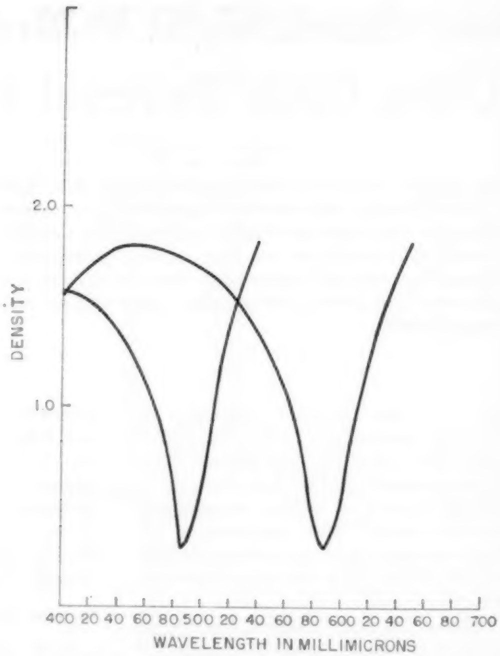

Fig. 2. Passbands of two Bausch & Lomb interference filters.

Polarizing Filters

One of the first methods that comes to mind when sky darkening is mentioned is the use of a polarizing filter. This filter depends for its action on the polarization of skylight. When placed over the camera lens a polarizing filter cuts out half the light coming from all objects and darkens relatively more those areas in which light is normally polarized. These include reflections from roads and water and an area in the sky at 90° to the sun measured in the plane of the observer. Light from sky areas close to the sun or near the horizon is not polarized enough to let the filter work well.

A scene was photographed first with normal exposure and then with a Pola-Screen filter over the camera. On this occasion, although the subjects were facing the sun, there was little sky darkening through the filter. A polarizing filter works best in very clear air and when the camera axis is not exactly horizontal. Unfortunately, one must regularly expose scenes in which sky areas appear that are not optimum for polarizing effect. Because of this and the fact that bright colors are unaffected by a polarizing filter, this method is not a good one for night-scene simulation.

Color Filters

In black-and-white photography a red filter is often used to darken skies and simulate night effects. Can such a filter be used in color photography?

The answer is no, since all parts of the picture would appear red, and even with the darker sky, the print would be unnatural. A blue or yellow filter, however, is not ruled out as quickly. A yellow filter would darken skies nearly as much as a red filter and might allow a more satisfactory balance in the final print. Since moonlight should appear rather blue, the yellow filter is not especially promising and will take considerable color timing in making a good print.

If blue is needed as a final color balance, why not start out by using a blue filter over the camera lens? Such an original would be easy to color-balance but would not help in reproduction of skies. Arguments on blue *vs.* yellow filters were interesting enough to include them in our search for better night effects.

A scene was exposed on Ektachrome Commercial Film using a yellow filter — a Wratten 12 — which passes only light of wavelengths longer than 500 mμ. The print on Type 5269 was balanced to have a yellow highlight and a blue shadow, and showed some sky darkening compared to a normal print, but red and green objects were reproduced at full brightness and the general appearance was unlike moonlight.

In testing the blue filter, a Wratten 47B over the camera lens admitted only light from 400 to 500 mμ and nicely cut out red and green reproduction. In addition the general print balance was not too far from that required for moonlight effects. Only the main problem remained — that of a bright blue sky.

Certain other filters with more or less blue density were also tried with no more success. After color filters were proved inadequate for night effects, exposures were made through narrow-band filters onto all three sensitive layers of the camera film, but in a way that might not record brightly colored objects. The passband of the two filters, shown in Fig. 2, is such that only light of wavelengths near 500 mμ and 600 mμ is admitted to the film. These are regions of low film sensitivity so that long exposure times and some adjustment in relative exposure were required to obtain a normal neutral scale.

A scene was exposed first normally and then using the two filters successively over the camera lens. While there was some suppression of red reproduction, the skies were bright blue and the overall effect was not far from the normal exposure. Apparently most colors in nature are broad enough in spectral quality that a narrow-band exposure sufficient to provide a neutral scale is also adequate for full color exposure. The problem of color wedging also arises in using interference filters before the camera lens, and a shift in color balance across the scene was evident in the pictures.

Overexposure

The undesirable color enhancement discovered in the first tests using underexposure made it logical to consider overexposure as a means to subdue color

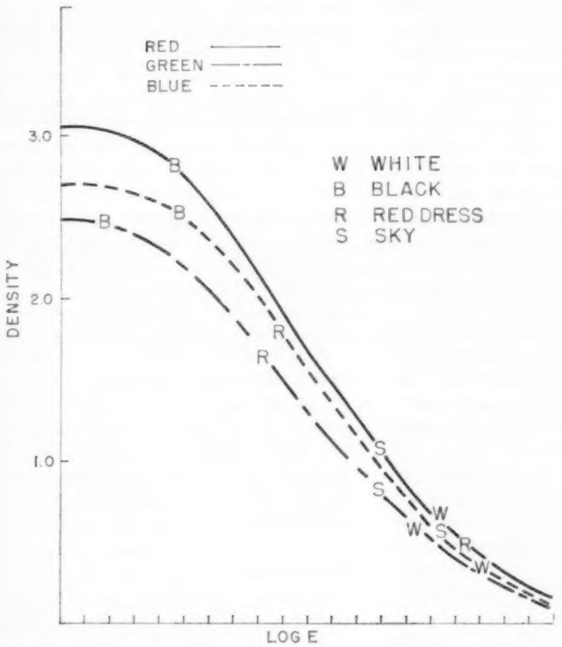

Fig. 3. Location of various picture areas on the characteristic curve of Ektachrome Commercial Film.

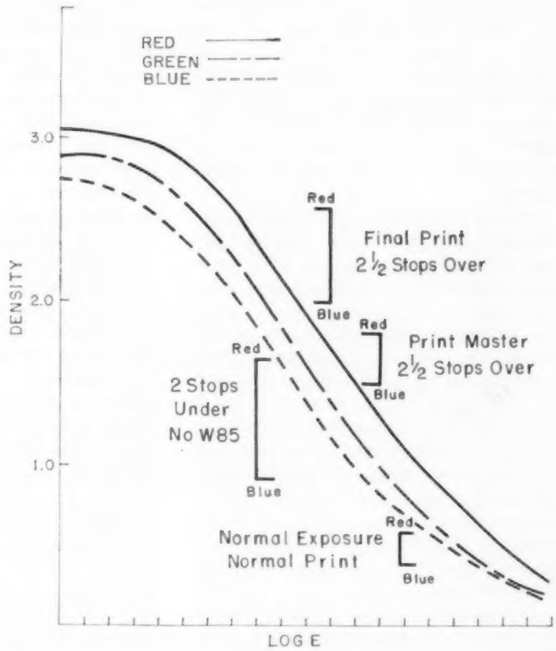

Fig. 4. Range of sky densities for four prints on Type 5269 film.

reproduction in night effects. Of course, an overexposed original would need considerable under-printing in order to get a dark screen result, but certain aspects of overexposure made the tests appear worth while.

To decide on a useful amount of overexposure, a number of picture density readings were taken using a densitometer with a 1-mm aperture. These readings are plotted in Fig. 3 on an Ektachrome Commercial characteristic curve. It is evident that most bright colors fall near the highlight end of the curve and that skies in particular are of low saturation and high brightness. Measurements on the log E axis show that about 2 to 3 stops of overexposure are required to "neutralize" the sky area. As more and more exposure is given the film, the blue record of the sky is moved to the right, i.e., onto the toe of the curve, followed closely by the red and green sky records. It takes about 3 stops overexposure to bring the average red, green and blue sky records coincident at D-min level.

When such a camera original is printed to a neutral or slightly blue "moonlight" balance, the sky area, while still bright, will no longer appear blue but will be as neutral as other normal highlight areas. At the same time, other brightly colored objects will be proportionately reduced in saturation, although some color will generally be retained.

A picture series was made including a normal exposure followed by scenes given 1, 2, and 3 stops overexposure. These four scenes were all second-generation prints on Type 5269 made from a Type 5269 printing master. The average density of each scene was matched as well as possible for all exposure levels, although there was considerable variation in overall density range.

Suppression of sky and other colors improves steadily as the camera film is given more exposure. This gain is accompanied by a compression of brightness range, which, while rather realistic, may not appeal to those looking for certain effects in night pictures. For each situation it will be necessary to compromise the gain in color suppression with the compression of the overall tone scale.

As one would imagine, printing an overexposed original to give a night effect requires a large shift in normal printer intensity. This change (about 1.50 log E for 3 stops overexposure) is beyond the range of intensity control on most printers. However, if the required timing were done in two stages using a printing master, then the work could be accomplished using the normal printer controls. The printing master can be introduced with no loss in quality since the final print is very dark, and graininess and color quality will not be important factors.

In addition to reducing the timing range required in printing, the printing master serves another useful purpose. The final print of a night scene must have shadow densities that are essentially at the D-max of the print film to avoid a "smoky" appearance. This is true regardless of the overall density range of the print. If such a print is made directly from an overexposed original, the shoulder compression of the print film gives a very short overall tone scale, and the print is not acceptable to most viewers. A printing master raises the contrast of the scene, allowing a final print to be made with shadows at D-max and with adequate density range to give acceptable highlights. This procedure permits one to gain the benefits from overexposure in sky and color reproduction without extensive loss of the tone scale.

It is informative to follow the tone reproduction of this two-stage system. In Fig. 4 the sky densities for several prints have been plotted on a control curve for Type 5269. It is easy to see the enhancement of sky saturation using 2 stops' underexposure and no Wratten 85 filter. Using 2½ stops overexposure, a suitable printing master gives a sky of medium density and with a blue saturation of only 0.30 units, which is due mostly to the overall color balance of the print. In the final print, the sky — one of the brightest picture areas — falls entirely above a density of 2.00 and again appears blue, mainly because of the usual blue balance of "moonlight" prints.

Prints from overexposed originals reproduce brightly colored objects in a way that is very similar to their nighttime appearance. These prints also produce a certain amount of tone compression, some of which is desirable in obtaining a moonlight effect. However, the same action that subdues color

reproduction also brings all highlights — sky, white objects and any artificial lights in the scene — to the same minimum brightness. This means that artificial lights, no matter how bright they may be, will not have the brilliance or glare that the dark-adapted eye is accustomed to seeing around bright sources.

In one scene taken at 2 stops overexposure, sky and color reproduction was acceptable, but when automobile headlights moved past the camera, they presented only a large white area, not the brilliant flash that was expected. When the original was given 2 stops underexposure, the headlight rendition was improved, but the blue skies and a bright red car reappeared. This inversion of two desirable features suggested that a compromise exposure might combine the good points of both exposure levels. A third scene taken at one stop overexposure did show some improvement in headlight "flare" without too much increase in sky coloring.

It now appears that the requirements for night-scene simulation lead to conflicting curve-shape and tone-reproduction characteristics, and that some compromise in exposure will be necessary. For each scene, the cameraman must pick the exposure level that will give the desired result with that particular lighting situation. It is recognized that tastes in night photography vary widely and that the neutral skies, subdued colors and realism obtained by means of overexposure may not appeal to all. In some cases a normal exposure printed heavy and blue will be all that is required. The one generality that can be made is that the camera exposure should lie somewhere between normal and 3 stops *overexposure*, rather than at 2 stops *underexposure*, as is now the case. The only virtue in the current practice is that release prints can be made directly with little color or intensity timing.

Other Night Situations

It is desirable to comment on two other kinds of night photography that are often confused in discussions of moonlight simulation. So far we have been talking only about simulating full moonlight effects by taking pictures in daylight.

It is often more effective and usually more desirable to use artificial lighting to simulate moonlight or other nighttime situations. Most close-up shots or other action taking place in a limited area can be illuminated using artificial lights to give any desired night effect. Here color and tone scale are under the control of the director and cameraman and may be manipulated at will. Combinations of tungsten, arc or neon lights can be used very effectively to simulate moonlight, street-lights, or the colorful mixtures found on a downtown street at night.

A single tungsten light placed above the model will simulate moonlight with the nighttime theme indicated by contrasty lighting and a cold color balance. In an interior scene, the room lights were 3200 K and moonlight was produced effectively by bringing unfiltered arc light through the window. A number of possibilities are available for photography using high-speed films and the existing lights of a city at night. Exposures were made using 24 frames/sec at $f/2$ on Ektachrome ER Film, Type B. A night effect is provided by the large range in scene illumination — over exposure next to store windows or near a theater — while shadows quickly fall to black. The effects of neon, fluorescent and mercury lamps add considerably to the nighttime appearance of the scenes.

One final situation deserves mention. It would seem reasonable after studying ways to simulate moonlight that one should at least try photography by actual moonlight. While we do not yet have color films fast enough for motion pictures in full moonlight, it is possible to check the result of such photography using a still camera and Kodak High-Speed Ektachrome Film. In this situation one should try to recall the actual appearance of a nighttime scene under moonlight — the sky, while colorless, is nearly always the brightest area in the scene; grass, flowers, and even the most highly colored objects appear as shades of gray with only artificial light sources adding any color.

A conventional daylight exposure was made of a garden scene in June; the exposure was normal for High-Speed Ektachrome Film at noon. Three additional pictures were taken at $f/2$ on the following midnight under a full moon. As the exposure was increased from 30 sec to 4 min and finally to 30 min, the scene was revealed substantially as it appeared in daylight. Full color rendition was obtained and a bright blue sky appeared with only an occasional white star trail to belie the daytime effect. In June, the positions of the full moon and sun in the sky differ greatly, causing different shadow angles in the two scenes. Another difference is that the film recorded warm patches of very faint street-light illumination unnoticed by eye at the time the picture was made.

Despite these differences, it is evident that comparable exposures made by moonlight or sunlight will give identical results providing the moon and sun are at the same place in the sky. We cannot look to real moonlight to give us the effects on film that our eye sees at night.

Conclusions

The central complaint in current night-simulation techniques, bright blue skies, has been eliminated by the overexposure method. At the same time, this technique introduces the other problems of too much highlight compression and the need for a printing master. These difficulties are not insurmountable, and a compromise exposure lying between normal and 3 stops overexposure seems to offer improved realism in outdoor night effects while maintaining the color and tone scale that most observers think they see at night and wish to see in night-simulation photography.

The use of indoor sets and artificial lighting is preferred for night effects whenever the action permits and a broad sky background does not need to appear in the scene. In the final analysis, the cameraman must evaluate the script, mood, action, and effect desired, balancing these against cost and time factors, in deciding the best night-simulation method for his situation.

Note: At the Toronto Convention, the various night-simulation techniques were illustrated with color motion pictures and slides. Illustrations of comparable value cannot be effectively reproduced in the *Journal*.

Autostereoscopic Lunar Photography

By LESLIE P. DUDLEY

When soft, manned landings on the Moon become practicable, efficient visual aids for group briefing and topographic instructional purposes will be needed. It is considered that stereoscopic photographs of the lunar surface which do not require the use of individual viewing devices would prove of value in this connection. The paper accordingly outlines a proposal for the production of such pictures from information transmitted from an orbiting space vehicle.

There are numerous different types of autostereoscopic photographs, that is to say, photographs which exhibit a stereoscopic effect without the necessity for the use of any form of individual viewing device by the observer. Of these types, an important group is comprised of those photographs in which vision of the "left-eye" and "right-eye" picture elements is restricted to the appropriate eyes of the observer by the use of a line screen or a lenticulated screen in close proximity to the picture surface. This group can be subdivided into three main types of photographs, these being *parallax stereograms, parallax panoramagrams* and *panoramic parallax stereograms.*

Full discussions of the parallax stereogram [1,2a,3a,4a,5–7] are available in the literature, so a brief description will suffice here.

This type of picture is constituted of a number of fine, parallel, vertical picture elements or strips. If we imagine these strips to be numbered consecutively 1, 2, 3, 4, 5...etc., then one series of strips, for example, that denoted by odd numbers, comprises the "left-eye" component of a stereogram, while the other series (that denoted by even numbers in this instance) comprises the "right-eye" component. This composite picture is mounted behind a suitable, matching line or lenticulated screen, and is seen stereoscopically when the observer is situated in one of a number of appropriate angular zones.

The practical applications of the parallax stereogram are somewhat limited owing to the fact that the stereoscopic viewing zones are separated by a similar number of equally wide zones from which a pseudoscopic view (right eye viewing the left-eye component, and vice versa) is obtained. Accordingly, it is necessary for the observer to exercise care in the selection of a viewpoint, and this can present difficulty, particularly in the case of a photograph depicting an unfamiliar subject, such as, for example, unexplored terrain.

The disadvantage referred to above is largely overcome in the parallax panoramagram, [2b,4b,8–10] with which type of photograph the width of the pseudoscopic zones is so reduced in relation to that of the stereoscopic zones that the former, undesired zones are no longer obtrusive.

The parallax panoramagram differs from the parallax stereogram in the following important respect. In the parallax stereogram, as we have seen, the composite photograph is composed simply of a large number of "left-eye" picture elements interdigitated between "right-eye" picture elements. In the case of the parallax panoramagram, however, this arrangement is not adopted. Each elementary vertical strip of the photograph consists not simply of a "left-eye" view or a "right-eye" view, but of a view changing progressively across the width of the element, from an extreme leftward aspect at one edge to an extreme rightward aspect at the other edge, of some particular vertical element in the original subject. A detailed explanation of how this is accomplished is given in the literature.[2b,4b]

In practice it is not difficult to arrange matters so that the angular width of the stereoscopic zones amounts to five, ten or more times that of the pseudoscopic zones. This fact and the fact that the parallax panoramagram provides an image which is both panoramic and stereoscopic constitute the main advantages which this type of photograph affords over the parallax stereogram. To offset these advantages, the simultaneous recording of all the aspects of a "continuous" composite image of the parallax panoramagram type is very difficult to achieve in practice. Consequently, it is customary for these aspects to be recorded sequentially, employing time exposures of the order of 1 to 10 sec or more. Further, the parallax panoramagram principle does not yield a photograph of good depth of focus. A typical parallax panoramagram camera designed by the author and used extensively for advertising and commercial photography is shown in the accompanying photograph, Fig. 1.

Many ingenious proposals have been put forward from time to time for the simultaneous recording of a large number (usually about fifty or more) of different picture-aspects with the object of simulating the continuity of image structure provided by a parallax panoramagram.

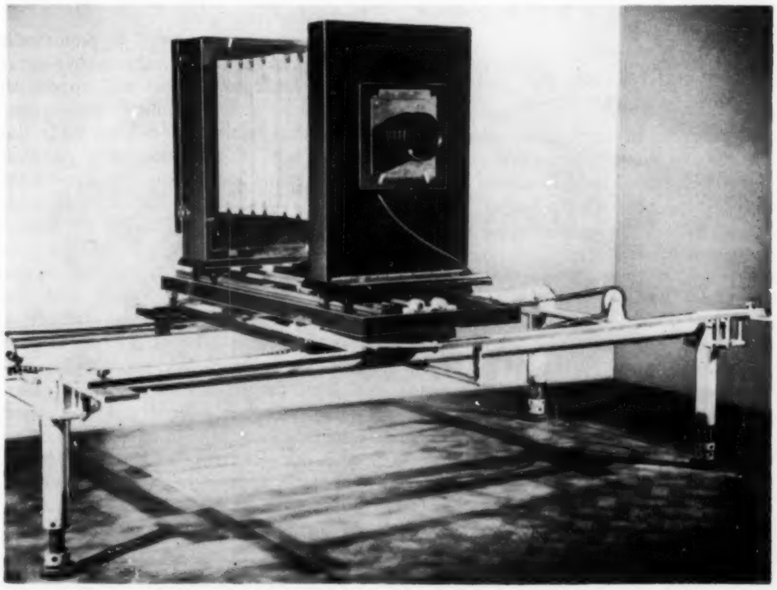

Fig. 1. Typical parallax panoramagram camera as used for advertising and commercial photography.

A contribution to the *Journal*, first submitted on October 28, 1960, and in final form on August 9, 1961, by Leslie P. Dudley, Leslie P. Dudley, Inc., 9460 Wilshire Blvd., Beverly Hills, Calif.

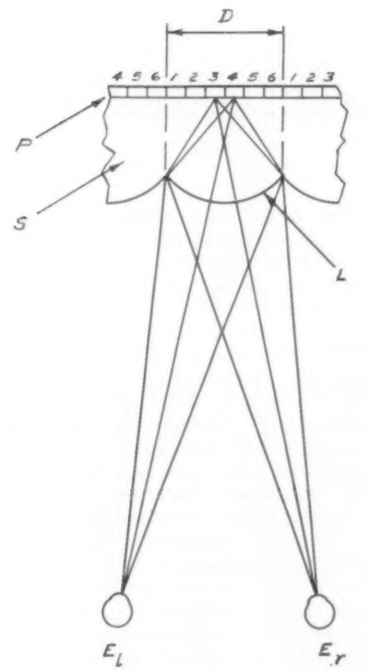

Fig. 2. Small section, shown greatly enlarged, of a 6-image panoramic parallax stereogram.

Of these proposals, some of the most interesting are those due to Clarence W. Kanolt[2c,4c,11,12] and Herbert Ives.[2d,4d,13] The difficulties inherent in these proposals, however, are so great that it would appear almost impossible to put such methods into practical operation The techniques of *integral photography*[2e–g,4e–g,14–17] show greater promise, but will not be discussed here, owing to the difficulties associated with their use in cases where a large stereoscopic base is necessary.

THE PANORAMIC PARALLAX STEREOGRAM

During recent years the author and others have done considerable research and development in connection with a further type of autostereoscopic photograph, known as a *panoramic parallax stereogram*.[3b] This type of multiple-image photograph resembles the ordinary parallax stereogram in that the plurality of aspects of the subject can be recorded either simultaneously or sequentially, according to requirements. It resembles the parallax panoramagram in that it provides a panoramic effect, and in that the angular width of the stereoscopic zones can be made sufficiently great in relation to that of the pseudoscopic zones to render the latter unobtrusive.

The advantages of the panoramic parallax stereogram result from the fact that the continuous type of composite image utilized in the parallax panoramagram is replaced by three or more discrete, interdigitated images. The viewpoints from which these separate images are recorded are spaced apart by an amount such that adjacent images constitute a stereoscopic pair. Thus, this approach differs from that of attempting to simulate a parallax panoramagram by recording the largest possible number of images with the smallest possible separation between adjacent viewpoints.

Referring to Fig. 2, the diagram represents a small section, shown greatly enlarged, of a 6-image panoramic parallax stereogram. In the illustration L represents one of the many cylindrical lenses comprising the screen S through which the picture surface P is viewed by the observer's left and right eyes, E_l and E_r. The interdigitated image strips are denoted by 1, 2, 3,...etc., the width of each strip being equal to $D/6$ where D is the pitch-distance of the screen or the width of one lenticule. The image in strip No. 1 is an element of the view representing the extreme rightward aspect of the subject, while that in strip No. 6 is an element of the view representing the extreme leftward aspect. The aspect represented by strip No. 1 is rightward compared with that represented by strip No. 2 by an amount such that Nos. 1 and 2 constitute a stereoscopic pair. Similarly, Nos. 2 and 3, 3 and 4, 4 and 5, and 5 and 6 also constitute stereoscopic pairs. As depicted in the diagram, the observer is viewing the stereoscopic pair represented by strips Nos. 3 and 4. By moving his head to the left or to the right, he can bring other pairs into view. If, however, he moves his head so far to the left or to the right that the 6|1 binocular field is presented to his eyes, hyperpseudoscopy will result. If he moves his head a little further in the same direction, the view will once again become stereoscopic.

The change in aspect, or panoramic effect, resulting from the above-mentioned head movements will appear to be of a smooth, continuous nature provided that all the factors involved in the production of the panoramic parallax stereogram have been appropriately chosen. The more important of these factors are: the disparity of aspect represented by adjacent picture elements, the number of such elements per pitch-distance of the screen, and the actual pitch-distance. In this connection it may, perhaps, be of interest to note that the author has successfully employed, for industrial purposes, panoramic parallax stereograms comprised of eight elements with screens of various pitch-distances ranging from 1/120 in. to 1/60 in. One of the cameras developed by the author for this class of work is shown in Fig. 3.

The camera illustrated employs No. 120 roll film, the finished pictures being produced in various sizes up to 12 by 15 in. (or 11 by 14 in.). By the simple expedient of using just two of the lenses, the camera can also be employed for the production of conventional stereo pairs (simple stereograms).

Interdigitation of a number of separate views to produce a panoramic parallax stereogram is a relatively simple matter, and is usually accomplished by a one-dimensional optical scanning operation. Thus, if n denotes the number of views recorded, each view must be reproduced behind the viewing screen in such a way that an appropriate element of that view occupies D/n of the pitch-distance D. This is achieved by projecting the views onto the photo-recording surface, one at a time and in the correct sequence, through a suitable line screen or lenticulated screen, the screen being moved laterally through a distance D/n between each of the n exposures. Projection of the views is carried out with the aid of a conventional enlarger, the screen-moving mechanism being similar to that employed in a parallax panoramagram camera.

A great advantage of the panoramic parallax stereogram lies in the fact that, as has been indicated, the final picture is customarily produced, both conveniently and effectively, from a series of normal, planoscopic photographs recorded from suitable viewpoints. It is this particular advantage, moreover, that is the main reason for the author's view that the panoramic parallax stereogram principle is likely to prove the most practical technique for the production of autostereoscopic photographs of the Moon. A method of adapting the principle to this application will accordingly be outlined a little later in this paper.

RESOLUTION

The useful resolution of a photograph cannot exceed the resolving power of the sensing device (the human eye in the case in which we are interested) by which the photograph is examined. Any such excess resolution will become useful only when the photograph is examined by a sensing device of higher resolving power or under higher magnification. Another point of importance to the topic under discussion is that we do not — in fact, cannot — devote critical attention to every part of a photograph simultaneously; we "scan" the area in a more or less random manner directed by the nature of the picture content and other factors. If we choose to control the mode of scanning by exposing to our view, not the entire photograph but, in succession, selected areas (e.g., parallel strips) of the picture, we are doing nothing to impair the resolution of the image. Moreover, systematic — rather than random — scanning may sometimes result in the observation of some important detail which might otherwise have been overlooked.

It is a fact that, with a panoramic parallax stereogram comprised of n images, an amount equal to $(n - 1)/n$ of the area of each image is suppressed during the interdigitating operation. Thus, with eight images, for example, only one-eighth of the area of each (original) image is utilized. This does *not* mean, however, that the resolution of the final photograph has been reduced to one-eighth of that of a normal, planoscopic photograph of the same overall area. If we could "put back" the discarded portion of each element, we would end up with a photograph having eight times the required area. The photograph would, incidentally, be anamorphosed in the sense that the entire increase in area would result from an eightfold increase in the width. In fact, to assume that any *useful* material has been discarded is just as erroneous as it would be, for instance, to assume that two hundred horses have been discarded in the production of an automobile. Clearly, the resolution of the autostereoscopic photograph, in its completed form, can logically be compared only with that of a single planoscopic photograph of identical size and shape. On this basis it can be shown that, in the majority of cases, the resolution of the former type of photograph is but little less than that of the latter type, the extent of the reduction being dependent primarily on the characteristics of the interdigitating and viewing screens. Moreover, any such reduction is usually more than offset by the fact that the picture enables the observer to employ both stereo acuity and vernier acuity in examining its content. In addition, through the panoramic effect obtained as the observer scans the picture, useful information may be disclosed which might, conceivably, have been completely missed by other photographic techniques.

The useful resolution of an ordinary, planoscopic photograph is limited, ultimately, by the resolving power of the observer's eyes. If his eyes are not perfectly matched, it is limited by the resolving power of the better of his two eyes, as he is capable of examining the entire area of the photograph with either eye. In the case of either a simple stereogram or a parallax stereogram, the position is a little less favorable. This is because, in either of these cases, each eye is capable of examining only one-half of the total area of the stereogram (neglecting, as we must, the pseudoscopic mode of presentation). Accordingly, the resolution is given approximately by the mean of the resolution achieved by the two eyes. The position is more favorable in the case of a panoramic parallax stereogram because, as we have seen, a relatively larger proportion of the picture surface is available for stereoscopic examination.

CIRCUMLUNAR PROBE

By taking advantage of the librations of the Moon, it is possible to obtain the requisite disparity of aspect, at an Earth-based station, for the photorecording of an ordinary stereogram. (The two components can, of course, be interdigitated to form a parallax stereogram, if desired.) Lunar stereograms of this type have been produced on various occasions in the past, but, whilst they are undoubtedly of interest, they are of limited value owing to the low resolution obtainable. The resolution obtainable in lunar photographs taken from the surface of the Earth is, in fact, limited by the effects of the atmosphere to about one-half mile. Clearly, therefore, something much better is needed in order to meet the somewhat severe requirements of the National Aeronautics and Space Administration.

Consideration of the various factors involved indicates that the most practical approach to autostereoscopic lunar photography is likely to be provided by the adaptation of the panoramic parallax stereogram principle to a circumlunar probe. Photographs produced by this technique could, in the near future, provide valuable information concerning the topography of the Moon. At a later date, when soft, manned landings become practicable, enlargements (or projection) of such photographs would no doubt prove of even greater value by providing a convenient and effective medium for group briefing and instructional purposes.

In February 1960, Project LAMP[15] was submitted to NASA by the Army Corps of Engineers, the objectives of the program being:

(1) to make a rapid and accurate (± 300 ft) three-dimensional survey of the entire lunar surface;

(2) to determine the characteristics of the surface of the Moon by multiple-frequency electromagnetic interrogation; and

(3) to produce topographic terrain and surface-property maps to be used in selecting scientific landing sites on the Moon.

This particular program is referred to here as it is one of several currently under review which could, without major changes, include an autostereoscopic technique within its scope.

In Project LAMP, there is the proposal that the sensing equipment shall be put into a near-circular polar orbit around the Moon, and maintained in this orbit for as long as is necessary to cover the entire lunar surface. It is estimated that the orbiting time will range from one lunar day (twenty-eight Earth days) to several lunar days, during which period all the required information will be gathered. The program envisages including in this information stereoscopic coverage derived by both television and photographic techniques. (It is presumed that the data will be stored pending subsequent transmission at a time when the space vehicle has been returned closer to the Earth, thereby providing a reduction in the necessary transmitter power and battery weight.)

Project LAMP is largely concerned with the production of maps, so it may, perhaps, be as well to emphasize here that the proposed autostereoscopic photographs are not intended for use in this connection. The photographs, when completed, would be viewed either direct or by projection and would in themselves constitute an end result. However, as will

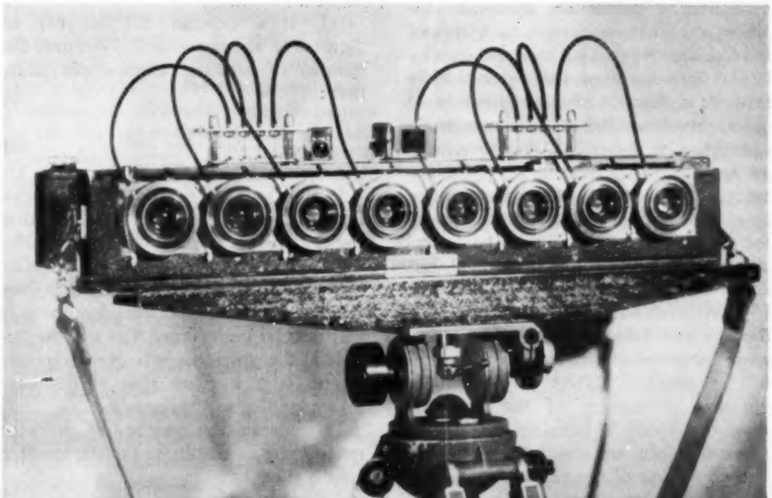

Fig. 3. Panoramic parallax stereogram roll film camera developed for use in industrial photography.

become evident, with appropriate programming of the sensing equipment to produce a series of pictures for a panoramic parallax stereogram, pictures from the same series will also be available for use in conventional photogrammetric and stereo photogrammetric techniques.

Project LAMP contains the proposal that the instrument package be put into orbit at an altitude of between 50 and 100 miles above the lunar surface. From some representative data given by Spaulding,[19] it is evident that at altitudes within this range, an axial resolution of about 25 to 50 ft can be attained. This data is based on the use of a catadioptric optical system, of 8-inch focal length and effective aperture ratio of 1.35, imaging on a ½-in. vidicon capable of 500 TV lines resolution on a 0.266 in. square format.

Spaulding shows that, using this equipment in an impacting lunar probe, a camera shutter speed of 10 msec would prevent image-smear exceeding one-half of a television line, based on a lateral component of velocity of 1,000 ft/sec at a height of 50 miles. In the case of an orbiting probe, however, it is evident that we will be concerned with lateral velocities amounting to five or ten times the above figure. Accordingly, shutter speeds of the order of 2 msec or less are indicated, but it seems that this would not be overtaxing the sensitivity of the equipment.

Let us assume, by way of example, that the instrument package is placed in orbit at a height of 75 miles above the lunar surface, at which height the resolution obtainable will be about 40 ft. We will imagine, further, that among the features to be recorded is a vertical object 300 ft high and of just-resolvable transverse dimensions.

In order to resolve both the top and bottom of the vertical object, it is necessary to create an apparent displacement, at the surface of the Moon, of not less than 40 ft. This corresponds to a lateral movement of the space vehicle through a distance of approximately 20 miles, resulting in a parallax angle amounting to about 7½°. However, with an apparent displacement of 40 ft, it is evident that we may just — or just not — be able to resolve the top and bottom of the object. Accordingly, it will be preferable to double the displacement and thus adopt a parallax angle of approximately 15°. With this angle of parallax, both the top and bottom of the object, plus some intermediate features, are certain to be resolved. Thus a panoramic parallax stereogram of the required resolution could be obtained from eight pictures taken at about 2° intervals. Interdigitation of the picutres would be carried out, by techniques already developed, after they have been transmitted to the Earth.

In the above example, an interval of 2° between successive exposures has been selected merely as indicative of the minimum interval necessary to ensure that, in the completed panoramic parallax stereogram, the 300-ft vertical object will be resolved. As will be understood, larger or smaller intervals can be selected according to requirements. It is to be noted here, moreover, that in the example pictures Nos. 1 and 8 would constitute a stereo pair exhibiting substantially the same parallax as that usually adopted in stereo mapping. They could, accordingly, be used for that purpose as well as for the provision of components of a panoramic parallax stereogram.

A convenient feature of the method discussed above is its obvious applicability to systems involving electrostatic imaging and recording[20] and to other techniques,[21,22] some of which are operational whilst others are under development. It is also to be noted that pictures of the type described may be viewed in conjunction with an autostereoscopic graticule,[2h,23] thereby enabling direct measurement to be made of dimensions normal to the picture surface.

APPENDIX

When a series of pictures, recorded from evenly spaced viewpoints, has been produced for eventual interdigitation into a panoramic parallax stereogram, it is sometimes convenient to consider the various ways in which two or more pictures in the series may be usefully combined. Thus, suitable pairs of pictures may be used for the production of simple stereograms, parallax stereograms, anaglyphs, etc., while suitable groups of three or more pictures may be used for the production of panoramic parallax stereograms. A few of the more useful relationships will accordingly be considered.

(a) If n denotes the number of pictures in the series and S denotes the number of available stereoscopic pairs, then:

$$S = \frac{n(n-1)}{2} \qquad (1)$$

With $n = 3$, for example, we see from Eq. (1) that S is also equal to 3. Denoting the individual pictures, in order, by p_1, p_2 and p_3, we can have the binocular fields: $p_1|p_2$, $p_1|p_3$ and $p_2|p_3$. Clearly, any other field would be pseudoscopic. It will also be understood that the magnitude of the stereoscopic base corresponding to $p_1|p_3$ is twice that of the base corresponding to $p_1|p_2$ or $p_2|p_3$.

In general, the number of different magnitudes available for the stereoscopic base is given by:

$$B = n - 1 \qquad (2)$$

From Eqs. (1) and (2) we find, for example, that with a series of six pictures we have available fifteen different stereoscopic pairs and five different magnitudes for the stereoscopic base. With a series of eight pictures, the corresponding figures for S and B respectively, amount to 28 and 7.

(b) A method sometimes adopted for increasing the effective stereoscopic base of a panoramic parallax stereogram is to omit, during interdigitation, alternate pictures in a series. Thus, let us suppose that a series is comprised of twelve pictures. We can produce a panoramic parallax stereogram from pictures Nos. 1, 3, 5, 7, 9 and 11 (or from Nos. 2, 4, 6, etc.), and thereby achieve an effective stereoscopic base which is twice as great as that which would result from interdigitation of the complete series.

(c) As has been indicated earlier, if n pictures are interdigitated in the form of a panoramic parallax stereogram, an amount equal to $(n - 1)/n$ of the area of each image is suppressed in the operation. There are, accordingly, n different selections of elementary strips that could, conceivably, be utilized in the case of each of the n images, yielding a total of n^n possible arrangements. With eight images, for example, we find that $n^n = 16.78 \times 10^6$. However, due to the effects of photo-integration and random grain distribution, no one of these nearly seventeen million pictures will differ sensibly from any other.

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The Cinematic Display of Numerical Solutions of Explosion Hydrodynamics Problems

By B. E. DRIMMER, A. D. SOLEM and H. M. STERNBERG

High-speed computers are used to solve explosion and shock problems. Each problem is set up as a grid system, each point having the physical characteristics of the corresponding position in the explosion system. Periodically the new positions of all calculated points are simultaneously displayed as dots on an oscilloscope screen, photographed, and later animated, providing rapid visualization of the motion. A motion picture shows such animation including comparison of a corresponding explosion event recorded at one million frames per second by a Beckman & Whitley Model 189 Framing Camera.

An important aspect of explosions research is the development of techniques for analyzing and interpreting explosion phenomena in terms of basic physical concepts and relationships. In its physical description an explosion can be considered as a problem in fluid dynamics. The computation of the flow of gases and metals following detonation can then be characterized mathematically as a problem in transient compressible flow. Complications arise in the diverse materials that must be considered, in the violent shocks, and in the rarefactions. However, the solution of many explosion problems of this type, out of the question less than ten years ago, is now being carried out by numerical methods on high-speed computers. The result of the calculations, giving material motions and values of the important thermodynamic variables as functions of time, is a large mass of numerical data presented in tabular form. An unavoidable adjunct to the calculations is the problem of how to present these data in a form readily accessible to the scientist and engineer.

This paper deals with a method for providing rapid visualization of the solutions to explosion dynamic and flow problems obtained on electronic computers. The method utilizes an auxiliary component of the computer, capable of displaying on a cathode-ray tube, the graphical forms of solutions developed by the computer. In solving such problems the distributions and motions (positions, velocities and accelerations) of the materials involved and their pressures, densities and internal energies are obtained at discrete times. Selected portions of these results (the positions of the points representing the materials, for instance) at each time of the calculations are then displayed simultaneously on the cathode-ray tube and photographed. Thus a frame-by-frame sequence of point positions for successive times is built up. This sequence can then be used for detailed frame-by-frame comparisons, or in a running animation, as desired in the analysis of the solution. The movie gives the scientist or engineer interested in the solution an invaluable overall picture of the flow, wherein he does not become lost in local detail. (An example of this data-presentation technique was given with this paper at the Convention.)

Presented on May 8, 1961, at the Society's Convention in Toronto, Canada, by B. E. Drimmer, A. D. Solem (who read the paper) and H. M. Sternberg, U. S. Naval Ordnance Laboratory, White Oak, Silver Spring, Md.
(This paper was received on June 5, 1961.)

Machine Computations and Their Graphical Display

This section contains a brief outline of the numerical computations and their conversion to a form suitable for cinematic display. The problems treated in the calculations are of transient compressible flow with axial symmetry. The equations that describe the flow are set up in finite difference form which are solvable on high-speed electronic computers. The physical system is mapped into a simple mechanical model by a grid system in which the intersections of the grid lines define a set of mesh points for which

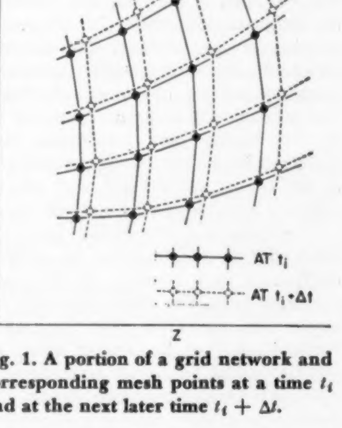

Fig. 1. A portion of a grid network and corresponding mesh points at a time t_i and at the next later time $t_i + \Delta t$.

(a) The material surrounding each mesh point is considered localized at the point when computing accelerations, motions and positions. The motions of the point are determined by the local densities, pressures and internal energies via the equations of motion and the equation of state of the material.

(b) The computation moves forward timewise. The results obtained at the previous time determine the next time step. A new set of results are computed for the new time.

Figure 1 shows the generalized concept of the grid lines and the mesh points as they might occur, first at time t_i and then

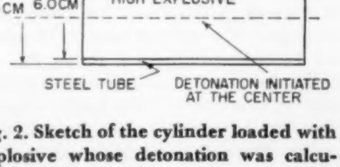

Fig. 2. Sketch of the cylinder loaded with explosive whose detonation was calculated and observed.

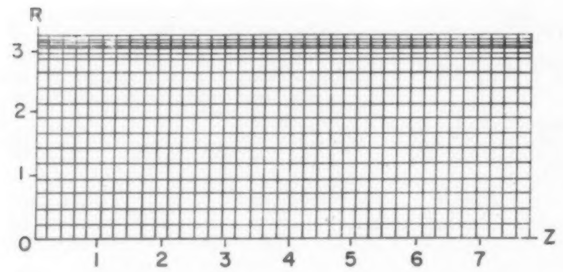

Fig. 3. The grid arrangement representing the experimental arrangement in the calculations. This is the configuration of mesh points at initiation of detonation.

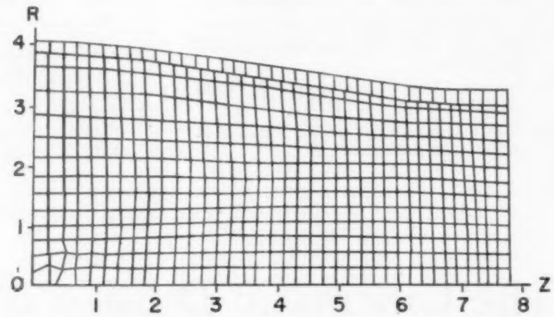

Fig. 4. The configuration of the grid arrangement 9.7 μsec after initiation of detonation.

at time $t_i + \Delta t$. A detailed description of the mathematical process is given by Orlow, Piacesi and Sternberg.[1]

Present-day, high-speed computers can handle problems involving 1500 to 2000 mesh points. For each point at each time some 15 quantities must be computed and retained. A problem will generally run through some 500 to 700 times. The solution of one problem thus develops about 10^7 calculated quantities which are normally printed out in tabular form. The solution will therefore consist of 500 to 700 tables, each containing some 20,000 to 30,000 entries. About one tenth of the results are printed out; the remainder being stored on magnetic tapes.

The capability for digital to analog conversion is provided for in auxiliary equipment in a number of computing machines (e.g., the IBM 740 CRT Recorder for the IBM 704 Computer). Here, instead of in tabular form, the output can be displayed as an array of dots on a cathode-ray-tube screen. It is possible to present, among other things,

- Positions of mesh points (x and y, or Z and R coordinates)
- Pressures as functions of position (P vs. x or Z)
- Isobar or isovelocity contours.

This gives immediate printout of the step-by-step progress of the solution for visual analysis and a permanent record on film for future reference and animation. This display does not replace the tables of the solution which contain the exact positions and other values calculated, but it does serve as a guide to what portions of the calculations must be examined in detail.

The Cinematic Display of a Detonating System

The detonation of an explosive charge in a metal cylinder and the subsequent motions that result are used to illustrate the technique. Figure 2 shows the arrangement: the explosive was Composition B; the cylinder was steel; detonation was initiated at the center of symmetry. The assignment of the grid system to the mechanical model must take into account the different materials; Fig. 3 shows the grid arrangement used in the example. The calculation need treat only one quarter of the physical system layout because of symmetry both about the axis and on each side of the plane normal to the axis that passes through the initiation point. In Fig. 3 initiation starts at the lower left corner and the motion progresses upward and to the right. It should be noted that the grid lines are not equally spaced: a fine grid network is used in the metal to permit a more detailed observation of the shocks and rarefactions in that region.

Figure 4 shows a plot of the grid network 9.7 μsec (microseconds) after initiation of the explosive charge. The detonation wave is just about to break through the free surface of the explosive on the right and the cylinder has started to move upward in the central region. Details of compressions and rarefactions in the metal can be seen. The rarefaction wave in the explosion gas is also evident. Figure 5 shows the system 15.0 μsec after initiation. The rapid motion of gases out the end of the cylinder is prominent.

Figure 6 shows prints of the mesh points seen on the cathode-ray-tube screen corresponding to the times indicated for Figs. 3, 4 and 5.

All frames collected on this problem (some 375 computational cycles spanning a real-time flow situation of approximately 15 μsec — apparent mean framing rate of 25 frames/μsec) have been animated into a motion picture which, as noted above, was shown at the Convention. The camera used to photograph the cathode-ray-tube screen produced images on 35mm film without concern for precise dimensions of the film frame size or registry with sprocket holes. In order to print on 16mm film reference points were established on the 35mm negative to index the image accurately within the 16mm frame size. Thus each image from the 35mm negative was individually positioned before printing onto the 16mm film strip. The animation then proceeded according to an established repeat schedule of individual frames from this indexed 16mm strip to display best the details of the flow. The motion picture clearly brings out the detonation wave in the explosive, the shock and rarefaction waves in the cylinder and its outward motion, and the rarefaction waves sweeping back into the gas.

Comparison With Experiment

The calculations have been compared to actual experimental explosive cylinder expansions. An arrangement iden-

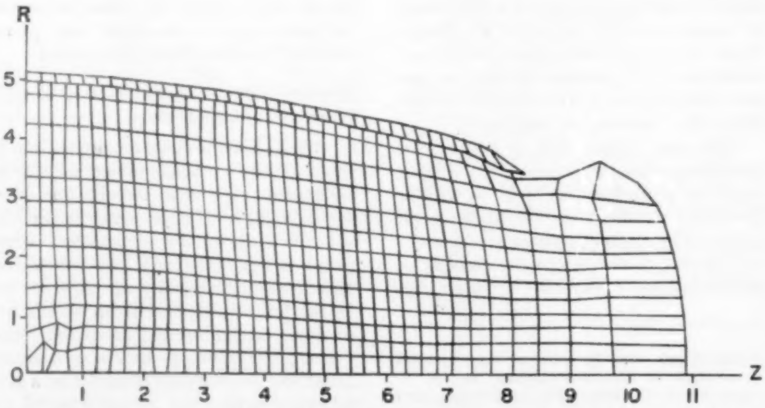

Fig. 5. The configuration of the grid arrangement 15.0 μsec after initiation of detonation.

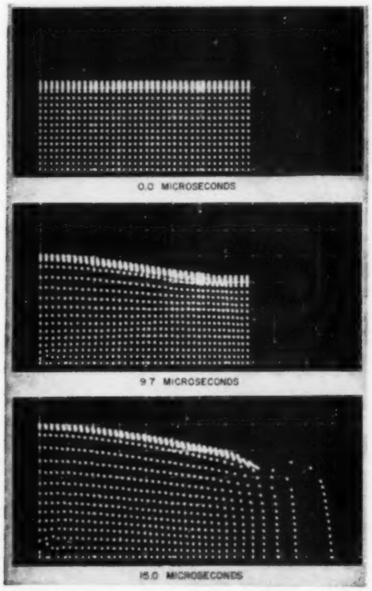

Fig. 6. Prints of the mesh points seen on the cathode-ray tube at 0, 9.7 and 15.0 μsec after initiation of detonation.

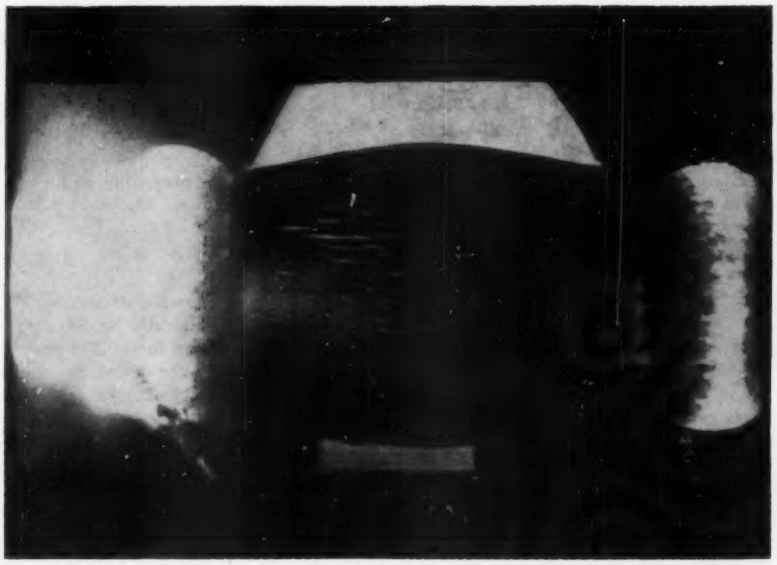

Fig. 7. Experimental observation of explosion and cylinder expansion 15 μsec after initiation of detonation. The horizontal cylindrical steel tube has become barrel-shaped as the hot explosion gases escape out of the ends of the cylinder. The contour of the steel tube is readily observed against the circular, brightly lit background. If coordinate axes are drawn through the axis of this "barrel," and then at right angles to this through the center of the barrel, the upper righthand quarter would correspond to the cathode-ray tube picture of Fig. 5 (15 microseconds).

tical to that described for the calculations, except for an axial cavity for the initiator, was used in the experiment. The explosion event was recorded by a Beckman & Whitley Model 189 Framing Camera, recording at a rate of one million frames per second. Figure 7 shows the frame corresponding to 15 μsec after initiation. The computed outside contour agrees with the observed contour within experimental error and the computed flow of gas out the end of the cylinder has a similar pattern to the observed flow.

Conclusions

The high-speed machine computations and the experimentally obtained high-speed, framing-camera pictures supplement each other very nicely as data-producing systems. For instance, the breakup of the cylinder, clearly evident in the photographic record, cannot at this time be described in the calculations. The calculations also do not account for the flow of gases out through these cracks at later times in the expansion. The detailed calculations and their animated, motion-picture display, on the other hand, present information not available from the experiment. They give, readily, cylinder accelerations and velocities. And most important, they permit *interior* "observation" into the motions which can only be inferred from the external high-speed photographic records.

Acknowledgments

The authors wish to acknowledge the assistance of the Photographic Division of the Naval Ordnance Laboratory and the U.S. Naval Photographic Center, U.S. Naval Air Station, Anacostia, in providing the excellent animations of the film strips obtained from the Beckman & Whitley framing camera and the IBM computer. They also wish to acknowledge the work of C. J. Brandner, who set up and ran the machine computations, and H. Katz, who performed the experiment which verified the calculations.

Reference

1. T. Orlow, D. Piacesi and H. M. Sternberg, "A computer program for the analysis of transient, axially, symmetric, explosion and shock dynamics problems," Naval Ordnance Laboratory NAVWEPS Report 7265, 30 September 1960.

Reversible Projector Equipment for Review-Rooms

By R. A. BULL

Certain economic advantages result from the use of reversing projection equipment in review-rooms, remotely controlled from the auditorium. The essential features of such equipment are described.

In the normal process of reviewing pictures in studios, whether rushes or completed reels, it is often required to repeat the viewing of certain sequences. These may be sections from large reels or advertising inserts, the running time of which may be anything from five minutes down to seven seconds. The sequence of operations required to give the repeat service is time consuming and in an attempt to reduce this time, a system has been developed which permits the film to run forwards or backwards through the projecting and reproducing mechanism and to be under the control of the viewer. The system is based on the British-made Westar Projector and Westrex 2003 Reproducer.

A typical time taken by a projectionist to lace a theater projector and sound equipment with which he is familiar, is of the order of 100 sec. This can be divided into about 40 sec for the preparation of the equipment involving opening spool boxes, pad rollers and gate and checking freedom from emulsion debris, and 60 sec for lacing. The total process involves some 28 to 32 distinct operations and motions. Since it is not continuously repeated, this work-cycle is of no particular significance in a conventional theater. In review-room work, however, and perhaps particularly in review-rooms handling advertising shorts, the period of this work-cycle can assume an economic significance.

Most review-room projection equipment handles married and unmarried prints and frequently there is a demand to repeat a whole reel or a sequence of a reel. It is not unusual for a short sequence to be repeated ten or more times. The work-cycle for the initial lacing of a double-film equipment is about 150 sec, of which some 45 sec is equipment preparation time. A request to stop the film, relace and repeat a given sequence, involves instruction over a communication system, the removal of the films from the equipment, their rewinding on a synchronizer and their relacing. Frequently the films are relaced at the initial start-marks. The work-cycle may typically be 300 sec to which must be added the time to run the film to the start of the desired sequence. If both films have footage marks, then the desired sequence can be identified from the picture film and the synchronization retained from the footage marks. This increases the work-cycle time but reduces the waiting period for the film to run through to the sequence. Not all film has footage marks and in practice such marks may be unreliable on coated magnetic film, since it is usually in repeated use and may therefore have been spliced. To repeat a short sequence ten times in a film length of 500 ft, can absorb 40 minutes solely in the work-cycle of handling the film. A less tangible but inevitable absorption of time is involved in communication between the viewers in the theater and the projectionist.

If a measure of automation is applied to the equipment, so that once laced the equipment may be started and stopped and run in either direction under the control of the viewer in the auditorium, an appreciable reduction of noneffective time is achieved. The initial lacing period and the starting and stopping period of the machine remain the same but the periods occupied in conveying instructions and the total work-cycle of removal of the film, rewinding and relacing are eliminated.

The requirements to be met by a remotely controlled reversing double-film projector mechanism may be specified as follows:

(1) The provision of drives to four spool positions so arranged that the function of feed and take-up can be reversed. Also, when a position is feeding film, the provision of a restraint on the film to avoid the formation of loops during deceleration or while the mechanism is stationary.

(2) The provision of a douser which opens when the film obtains normal speed in either forward or reverse direction, but which closes immediately volts are removed from the main drive-motor.

(3) The provision of switching arranged so that the sound is muted except when the mechanism is running forward at normal speed.

(4) The provision of two conditions of film tension in the gate so organized that the tension is substantially reduced below normal immediately before the mechanism reverses, remains in this condition while the film is running backwards or decelerating to rest and reverts to normal only after the film is stationary.

(5) The switching for the remote control of the equipment to be of the simplest character and the projectionist to be provided with an immediate override to cover emergencies.

In addition it was arbitrarily decided that the complete mechanism should be designed to handle 2000 ft of married film with either photo or four-track magnetic sound and 1000 ft of unmarried film with either photographic or 200-mil single-track magnetic sound and that there should be a choice of either induction, synchronous or interlock main drive-motors working from either single- or three-phase supplies.

The drive requirements of the four spool positions was met by the use of direct-drive torque-motors. The restraint on the film from play-off spool positions to avoid loop formation when decelerating and coming to rest, is obtained by applying reduced voltage to the torque-motors. This reduced voltage is applied to all four motors during all stationary periods but is increased on the two motors performing the take-up function during the running of the film. The standard film core diameters $2\frac{1}{4}$ in., 4 in. and 5 in. may all be encountered in review-rooms. It was found impracticable to cater for this range of core diameters without adjustment of the torque-speed characteristic of the motors. A manually operated switch has therefore been introduced to select an appropriate drive voltage depending on whether $2\frac{1}{4}$ in. or larger diameter cores are employed.

Experimental work was necessary to establish the proper conditions for reversing the film through the projector. An essential objective was to retain a high degree of definition of the projected picture during reversed running. Since the upper feed-sprocket becomes, on reversal, a hold-back sprocket, it was necessary to introduce a roller positioned within the normal loop between this sprocket and the gate. In the Westar projector, the gate opens by parallel motion along the optic axis and it was found that the design had unanticipated virtues for reversed film operation. By reducing the gate tension, the film not only traversed the gate satisfactorily but the projected picture showed only a

Presented on May 10, 1961, at the Society's Convention in Toronto, Canada, by Austin G. Cooley, for the author, R. A. Bull, Westrex Co. Ltd., 152 Coles Green Rd., Cricklewood, London N.W.2, England.
(This paper was received on March 24, 1961.)

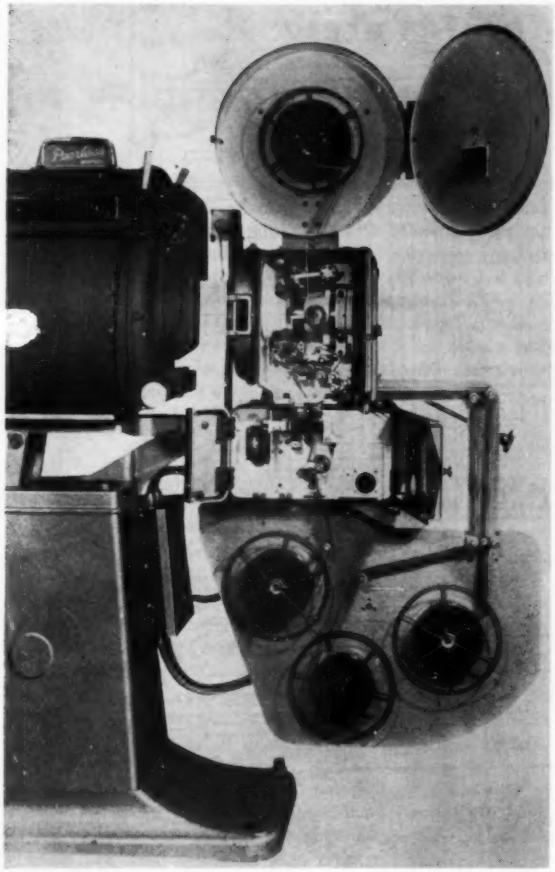

Fig. 1. Double-film reversing projector assembly. The rotary solenoid, with link mechanism for releasing gate tension during reverse running, can be seen in the upper righthand corner of the projector.

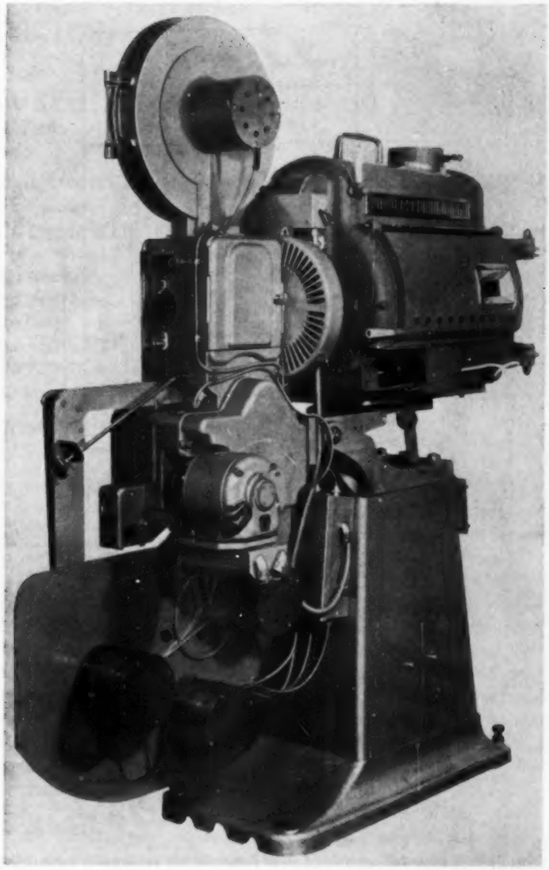

Fig. 2. Double-film reversing projector showing direct-drive torque-motors.

modest degradation from normal sharpness. Further, the tolerance of this reduced gate pressure to give satisfactory film operation, was reasonably wide. This permitted the alternative gate pressure to be obtained by using a rotary-type solenoid operating on the conventional gate opening mechanism through a simple linkage with adjustable stops.

The only other change made to the projector was to replace the usual frictional-type shoes on the intermittent sprocket, by four small ball-races. No mechanical change was necessary to the sound reproducer for reversed operation. Figures 1 and 2 show general views of the reversing double-film assembly adapted for reproducing photo-track and 200-mil magnetic sound. If in addition it is desired to reproduce four-track magnetic sound, a standard penthouse reproducer is added to the projector. The four direct-drive torque-motors can be seen in Fig. 2.

The control circuits to give the desired sequential switching to the complete assembly employ relays associated with adjustable R-C delay circuits. A schematic of the control is shown in Fig. 3. A switch on the control permits conventional manual operation of the mechanism to be employed. When set to "auto," the sequential switching circuits are introduced and a second switch can hand over to the remote control unit. The schematic of this unit is shown in Fig. 4.

This control is a small unit with three self-illuminated pushbuttons which are marked *Forward*, *Stop*, *Reverse* by three illuminated legends adjacent to them. When the remote control unit is switched into circuit, the legends are illuminated. If the forward button is pressed its internal lamp lights, the machine starts and when up to speed, the douser opens and a relay contact removes the muting of the sound circuit. When running forward, the reverse circuits are inhibited and there is no response to operation of the reverse button; conversely, when running in reverse, the forward circuits are inhibited.

To reverse the machine, requires that the stop button is pressed followed by the reverse button. A simple memory circuit holds the instruction to reverse until the machine has come to rest. On pressing the stop and reverse button, the lamp in the forward button is extinguished and the one in the reverse button is illuminated. The time interval between pressing the stop and reverse buttons is immaterial, only the sequence is important. When these buttons are pressed the douser closes, the sound is muted and the volts are removed from the drive-motor. The machine decelerates to rest and remains stationary for a period of 1 to 2 sec. During the stationary period the rotary solenoid releases the tension in the gate, the voltage is decreased on the two take-up motors and increased on the two motors which now have to perform this function, the connections are changed to the drive-motor for reverse operation and finally the voltage applied to the drive-motor. The machine accelerates and when normal speed is reached, the douser opens, the sound remaining muted.

To bring the machine to normal forward operation, the stop and forward buttons are pressed in sequence; the resultant automatic operation is the converse of the previous sequence, except that when the machine reaches

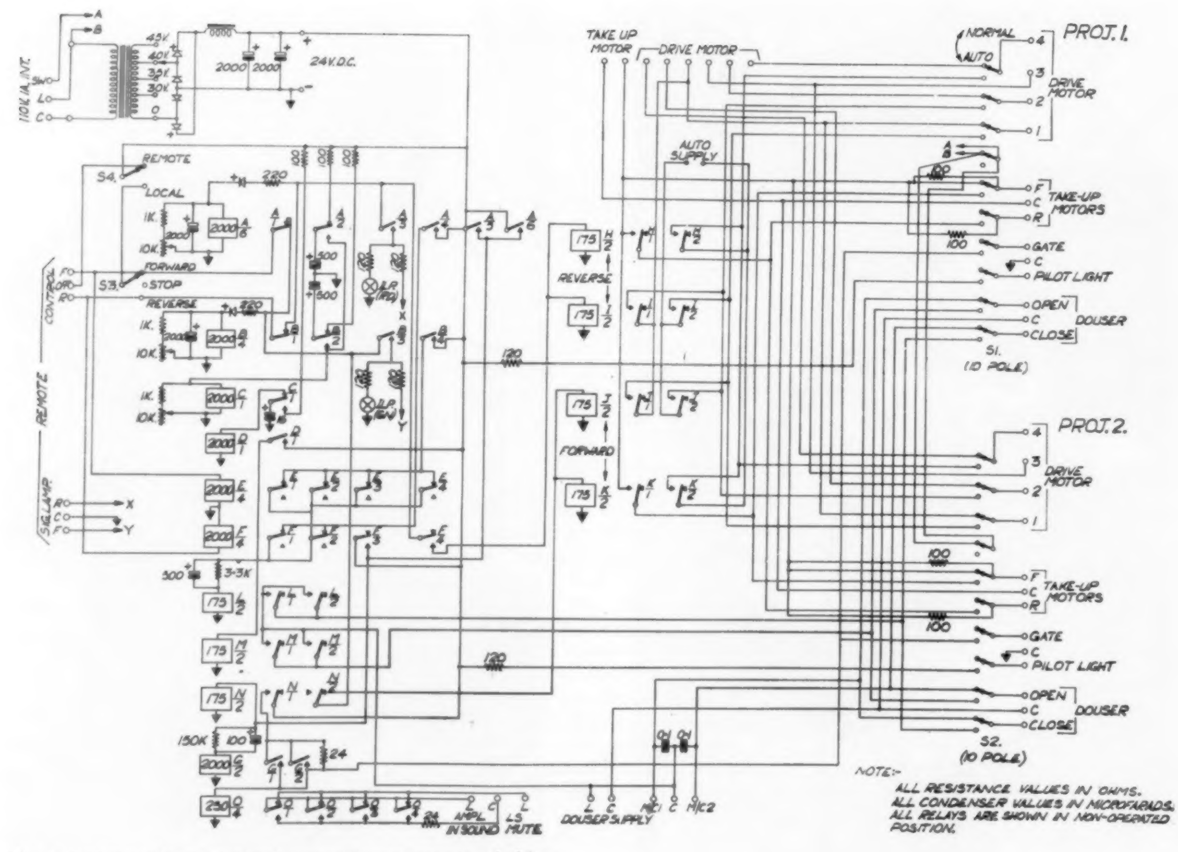

Fig. 3. Skeleton schematic of unit controlling sequence switching.

normal speed, the opening of the douser is accompanied by the opening of the sound muting circuit. If the stop button only is pressed while running in reverse, the machine comes to rest and when stationary, the normal gate tension is restored and the voltage on the two torque-motors performing take-up function, reduced to the "film restrain" condition.

To illustrate the time saved by the use of a remote controlled reversing mechanism, a trial was made of running 450 ft of unmarried prints, the last 90 ft being repeated to give a total of ten viewings. Using the conventional method of rewinding and relacing to initial start-marks, the exercise took 90 min 30 sec; using remote controlled reversing techniques, the exercise took 40 min 30 sec. A similar trial of repeated viewing of an advertising short consisting of

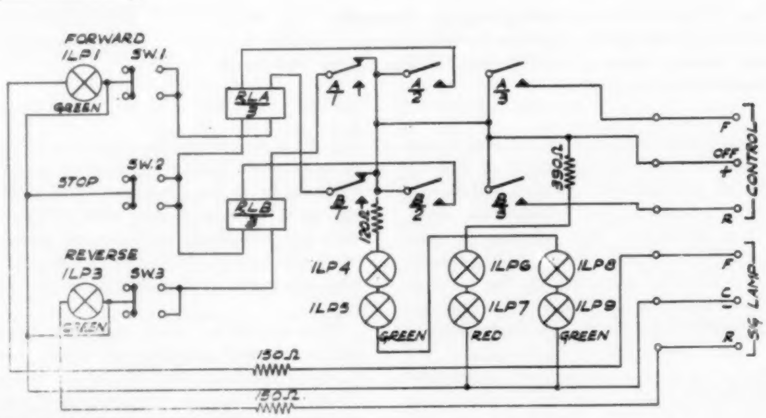

Fig. 4. Schematic of remote-control unit.

15 ft of unmarried prints, gave the following results. Again the viewing was repeated ten times. The time taken using conventional projection was 44 min 50 sec; using reversing techniques, 21 min 15 sec.

Artificial Reverberation Facilities for Auditoriums and Audio Systems

By G. R. CRANE
and G. A. BROOKES

Two new equipments for producing artificial reverberation are discussed. One is used to increase the effective reverberation time of churches or other auditoriums where the natural reverberation time is below the desired value. The other is intended for audio studio application to introduce special effects. The artificial reverberation is produced in a magnetically recorded multiple-output memory system. In the auditorium application, the reverberation information is fed to a series of side-wall speakers which simulate a series of reflecting surfaces, each set receiving its own distinctive reverberant information. In both auditorium and studio applications, the reverberation time and reverberation frequency response can be controlled over a wide range.

Several artificial reverberation systems have been introduced in the last few years which employ novel means of producing delayed repetitions of the original signal. Some types introduce undesirable side effects such as mechanical noise, microphonics or resonance. Others lack the range of control which is extremely desirable in broadcast and recording studio applications. Few, if any, have adequately provided for "live" program material in auditorium applications.

The reverberation generating equipments described in this paper utilize high-quality magnetic recording and reproducing techniques which in themselves are not entirely new for this application. However, special design considerations and functional innovations have been incorporated which greatly add to the naturalness and dramatic quality of the reverberation effect and to the flexibility of the system.

REQUIREMENTS OF ARTIFICIAL REVERBERATION SYSTEM

Review of Reverberation Effect

Before describing the units which have been developed, it would be well to review briefly the nature of the reverberation effect and to discuss some of the factors which have to be considered in the design of reverberation systems.

As is well known, a sound generated within an enclosed area will be propagated in all directions and will suffer successive reflections and absorptions until the energy is completely absorbed by the reflecting surfaces and the air. The rate of decay of the sound is determined by the rate of absorption and this in turn is dependent upon the volume and shape of the room as well as the nature of the reflecting surfaces. The volume and shape of the room will naturally determine the length of the mean free path for the sound and hence the mean delay between successive reflections.

By definition, reverberation time is the time required for the original sound to be attenuated by 60 db as a result of the multiple reflections and absorption, as discussed above. Conventionally, this time is quoted for a single frequency, usually 512 cps. However, in the general case the reverberation time will vary considerably over the audio freqeuncy range.

Experience has shown, that on a subjective basis, there is an optimum reverberation time and optimum reverberation time-frequency characteristic for any auditorium which varies with the volume of the auditorium and with the subject matter presented. As an example of the variation of the optimum figure with frequency for a room of cubic dimensions of 10^6 cu ft. the optimum reverberation time at 100 cps may be in the order of 0.7 sec greater than for 500 cps.

Figure 1 has been prepared[1] to indicate approximately how the optimum reverberation time varies with type of program material and rooms of different volume.

The optimum reverberation time for dialogue is relatively short, in order to provide maximum clarity and intelligibility of each syllable. However, such an acoustic condition is detrimental to pleasing rendition of music. Furthermore, the optimum reverberation time for different types of music material also varies. As will be noted from Figure 1, the range of optimum reverberation time between dialogue and, say, organ music may be in the order of 0.5 sec or more.

System Requirements

It will be appreciated that any system designed to closely simulate the reverberation effect must provide the following features. First, and fundamentally it must simulate a series of multiple re-

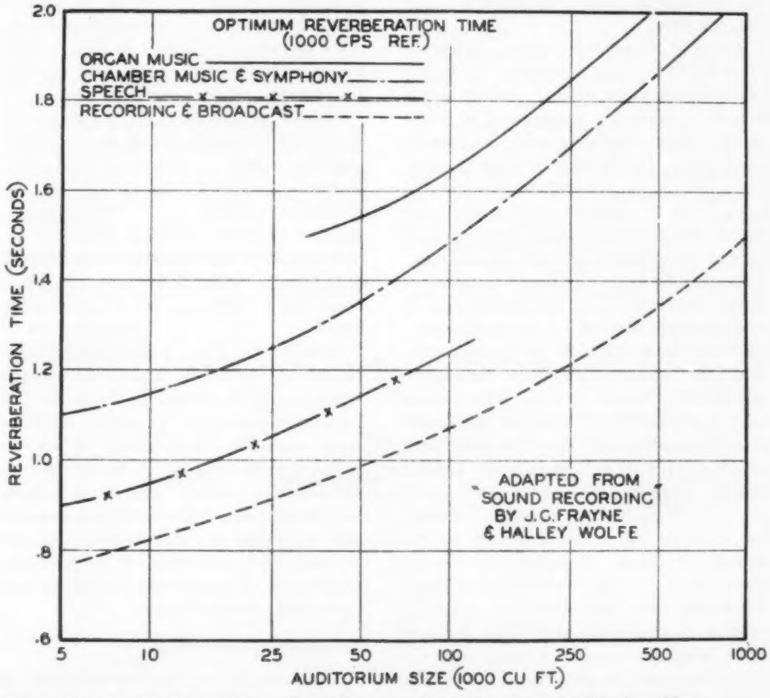

Fig. 1. Graph of Optimum Reverberation time Plotted Against Auditorium Size.

Presented on May 10, 1961, at the Society's Convention in Toronto, by E. A. Dickinson for the authors, G. R. Crane and G. A. Brookes, Westrex Company, a Division of Litton Systems, Inc., 335 North Maple Dr., Beverly Hills, Calif. (This paper was received on February 25, 1961.)

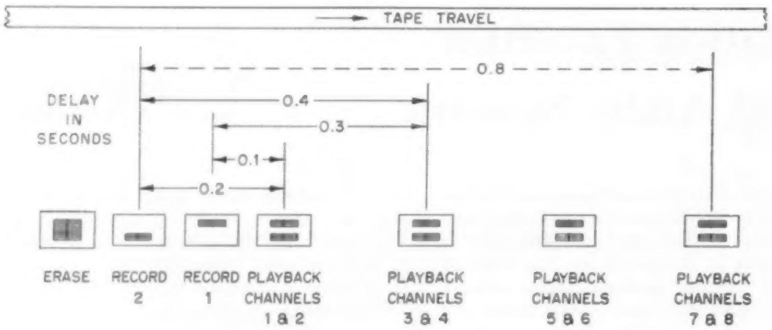

Fig. 2. Record/Reproduce Head Spacing.

flections. Second, it must be capable of providing the desired reverberation time. Third, the effect of variation in absorption over the frequency range must be accomplished. Finally, for maximum utility in an auditorium used for a variety of purposes, all of the above features should be readily adjustable from an appropriate control position.

Record-Reproduce Cycle

If we now consider a record-reproduce cycle which employs magnetic tape, it will be obvious that a signal can be recorded and subsequently reproduced at the reproduce head. The time delay so introduced will be dependent both upon the speed of the tape and the physical spacing between the recording and reproducing heads. By the use of a series of reproducing heads it is possible to provide a succession of delayed signals, and with suitable adjustment of the relative output level of each reproducing circuit it is possible to effect a decay characteristic.

To give a smooth decay, however, of sufficiently long duration, it would be desirable to provide an infinite number of reproducing heads and to have these heads closely spaced. Minimum head spacing is limited by head dimensions, but it is possible within certain limitations to increase tape speed and adjust the relative output level of successive reproducing circuits accordingly. This may be best visualized by taking a simple example. Let us assume that a reverberation time of 1.5 sec is required, that the tape speed is 20 in./sec, and that the spacing between successive reproducing heads is 1 in. This means that the time delay between successive reproductions is 0.05 sec. The difference in level between reproduced signals should then be $60/(1.5 + 20)$ or 2 db and 30 such delayed signals would be involved in a 60-db decay to establish a decay characteristic equivalent to a 1.5 sec reverberation time. Increasing the tape speed by a factor of two or decreasing the head spacing by a factor of two would mean that the difference in output level between heads should be 1 db. If we retain the same tape speed and head spacing it will be appreciated that the apparent reverberation time can be varied by suitable adjustment of the relative output level of the reproducing circuits and feedback paths. There is obviously a practical limit to the proximity of head spacing. Considerations of head wear and transport design dictate the limitations of maximum tape speed.

Reverting to the discussion of the number of reproducing heads required, whereas in order to provide an essentially smooth decay characteristic, it is desirable to provide a large number of reproducing heads, economic considerations reduce the actual number which can be employed. This problem is solved by taking the output signal from the last reproducing circuit through a feedback path and injecting it into the recording circuit at a level compatible with the required decay characteristic.

Some further economy can be effected by reducing the number of reproducing head assemblies as distinct from the number of reproducing heads. This approach is shown in Fig. 2. The function of the erase head shown in this illustration will be discussed later.

It will be noted that two staggered half-track recording heads are provided, together with a series of half-track, in-line reproducing heads. If the information which is to be reverberated is applied to both recording heads simultaneously, it will be seen that a delay of 0.1 sec is obtained between recording head No. 1 and Channel 1 reproducing head.

A delay of 0.2 sec is obtained between recording head No. 2 and Channel 2 reproducing head and so forth. In this particular example, a saving of three head assemblies is effected. If the recording medium is in the form of a continuous loop rather than on a reel-to-reel basis, then obviously it is not necessary to reload the transport at the end of each reel. However, it is necessary to provide an erase head to remove any previously recorded signal.

Frequency Characteristic

With respect to the introduction of other than a flat frequency characteristic, this can be achieved by the provision of adjustable equalization in each reproducing circuit, or in certain applications to be discussed later, by merely equalizing the total output from the reverberation system.

Summary of Basic Provisions of System

Summarizing the above, by providing a series of reproducing heads a series of reflections can be simulated. The differences in mean free path of different rooms and hence reverberation characteristic can be simulated by selection of reproduce head spacing or tape speed changes, together with suitable adjustment of relative output level from reproducing heads and level of feedback signal applied to the recording head. The simulation of reverberation frequency characteristic can be effected by the introduction of suitable equalization to the reverberation signals.

THE DISTRIBUTED REVERBERATION SYSTEM

Let us now consider the application of the system to introduce artificial reverberation into an auditorium. Figure 3 shows the simplified schematic circuit of such a basic system.

The outputs of a series of microphones are connected through microphone preamplifiers and a mixing network to a recording amplifier and pairs of recording heads as described previously. The output of each reproducing head is connected, through appropriate amplifiers, to a separate pair of loudspeakers which are mounted on opposite sides of the auditorium. The reproduced outputs of greater time delay are connected to speaker pairs further to the rear, in the auditorium. The number of reproducing circuits and speakers provided will depend on the size of the auditorium and also upon the nature of the reverberated signal.

Generally, it has been found that the provision of eight reproducing circuits with a time delay of 0.1 sec between them has been very satisfactory for the reproduction of choral and organ music. It will be noted that provision is made for adjustment of relative output level of each reproducing amplifier and that this is shown in the form of a potentiometer control. This could equally well be a series of fixed resistors, the value of which could be changed simultaneously from some remote control point to establish a different output level and hence decay characteristic. This facility would permit instantaneous change as the type of program material was changed.

The equalizers in each reproducing path are of the type which permit adjustment of both low- and high-frequency boost or attenuation as required, depending on the natural acoustic char-

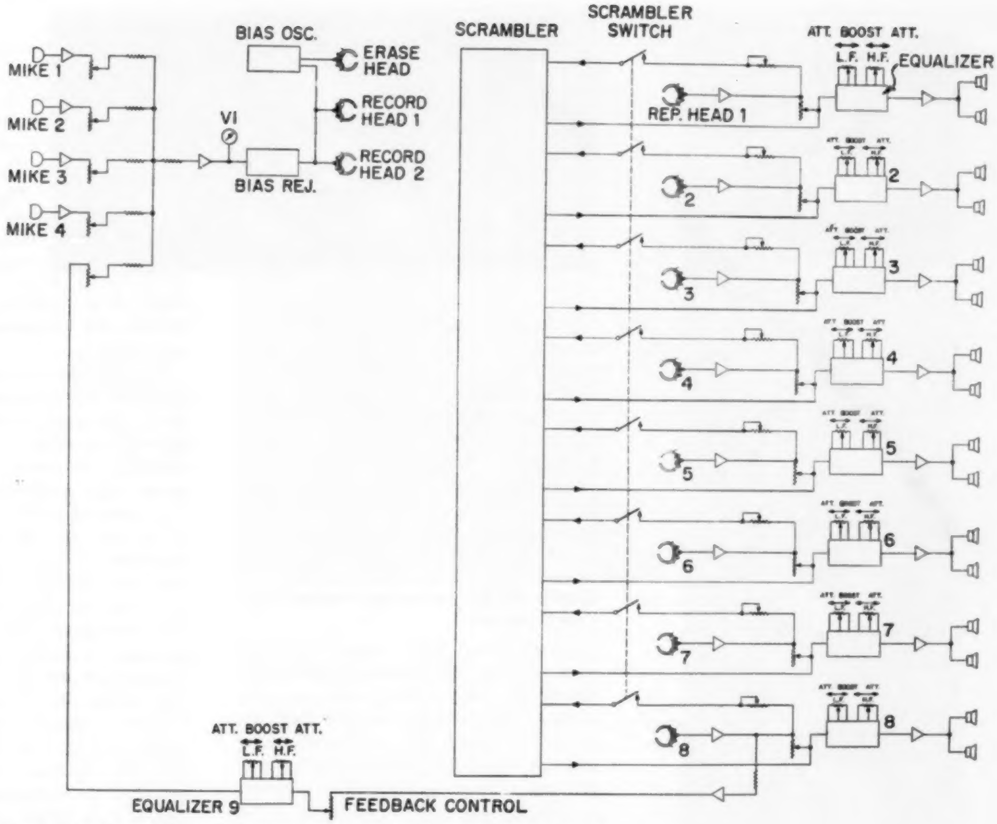

Fig. 3. Distributed Reverberation System—Simplified Block Schematic.

acteristic of the auditorium and the particular effect desired.

The feedback path from the last reproducing head will be noted as well as the erase circuit, both of which have been discussed previously.

Let us now assume that a pulse is recorded. It will appear at the output of each reproducing circuit successively and at a successively decreasing intensity level by virtue of the setting of the output potentiometers. After reproduction from the last head, the signal will be re-recorded by virtue of the feedback circuit connection and the process will be repeated until such time as the signal is completely attenuated.

It will be obvious, however, that the effect will be that of a series of pulses which will apparently travel in succession from front to rear of the auditorium and subsequently be repeated at a lower level. If we now interconnect the speaker circuits in some fashion so that in addition to the information received directly from the associated reproducing amplifiers, additional information is received from other channels then the true random reverberation effect is approached. Such an interconnection is shown in block schematic form by the block labelled "Scrambler" in Fig. 3. It will be appreciated that if, for example, we transmit a portion of the output of, say, Channel 8 to Channel 1, then the level of the secondary signal relative to that of the primary signal should be lower since the secondary signal is simulating a longer delay.

Conversely, if a portion of the signal from Channel 2, say, is connected to Channel 5, the added signal will have to be at a higher level than that of Channel 5 since it is simulating a signal which has suffered less delay. The determination of the most suitable interconnection arrangements is best achieved by on-site tests at a particular installation.

The Effects Reverberation System

Let us now consider a reverberation system which would be used for effects purposes in recording or radio studios. The block schematic of such a system is shown in Fig. 4. The drawing shows a single-channel system but is typical also of the circuitry of a multichannel system. A portable multichannel variation of this system is in fact being used for "live" productions and will be discussed in some detail later.

Slight variations of the previously described system for auditorium application will be seen. The input signal is applied to the recording head through the recording amplifier circuit as before. A succession of reproducing heads, reproducing amplifiers and feedback cir-

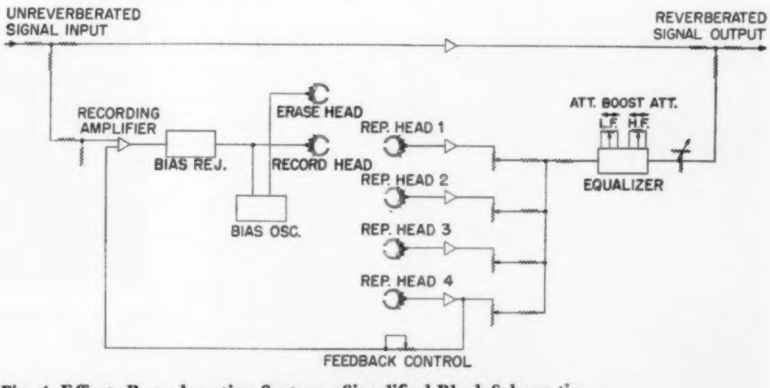

Fig. 4. Effects Reverberation System—Simplified Block Schematic.

Fig. 5. Distributed Reverberation System—Equipment Cabinet.

Fig. 6. Distributed Reverberation System—Mixer Panel.

cuit as well as erase facilities are again provided, but since a single output is involved, control of the frequency response of the reverberated signal is effected by a single equalizer in this output. It will be noted that the outputs from successive reproducing circuits are connected together and then combined with the original signal. Control of the level of the reverberated signal relative to the original signal is effected by the attenuator in the reverberation output circuit. The slope of the reverberation characteristic is determined by the setting of the output level of each reproducing amplifier and by adjustment of the feedback control. Some audio engineers prefer to keep the feedback control fixed and to vary the effective reverberation time merely by controlling the amount of reverberation mixed with the live signal.

Distributed Reverberation Equipment Unit Description

Figure 5 is a view of the equipment used in the distributed reverberation system for auditorium application. The main items of interest in this view are the mixer panel with associated input controls and volume indicator meter, and the tape transport panel which is below it. The bottom unit in the rack is the equipment power supply. The remainder of the electronic equipment with the exception of the power amplifiers which are in a separate rack is mounted behind the blank panels.

Mixer Control Panel

The mixer control panel is shown in more detail in Fig. 6. Controls are provided for four microphone input circuits and indication of recording level is given by the volume indicator meter. All microphone preamplifiers are of etched circuit board construction and employ vacuum tube circuitry.

Film Transport and Tape Cartridge

Figure 7 is a close-up view of the film transport which shows the tape cartridge. This cartridge is easily replaced and contains a 225-ft loop of durable, dry lubricated $\frac{1}{4}$ in. wide magnetic tape.

The capstan can be seen at the right-hand side of the illustration and beneath this is the puck which is shown in its retracted position. When the unit is energized, the puck is engaged with the capstan by actuation of a solenoid. The width of puck is greater than that of the tape and the puck therefore engages the capstan outside the tape area. Since the coefficient of friction between the puck and the film is greater than that between the film and the capstan, the majority of the drive is effected by the puck on the oxide side of the tape. The rubber covered drum in the lower lefthand corner is attached to a flywheel which is driven by belt action of the film and effectively removes the minor motional disturbances imparted to the tape as it is drawn out of the center of the tape cartridge.

The capstan is provided with precision bearings and a high-inertia, belt-driven flywheel. An improved belt design insures excellent tape motion with high reliability. Normal tape speed is 10 in./sec. Other optional speeds of 5, $7\frac{1}{2}$, 15 and 20 in./sec are available for other ranges of effective reverberation time or simulated mean free path.

Magnetic-Head Assembly

Figure 8 is a view of the tape transport with the head shield cover removed. From left to right can be seen a full-track erase head; two staggered, half-track recording heads and four dual pairs of half-track in-line reproducing heads.

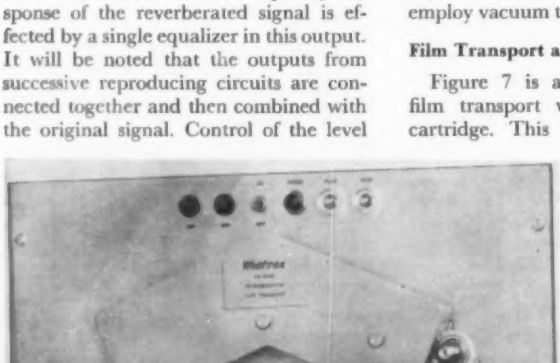

Fig. 7. Distributed Reverberation System—Transport.

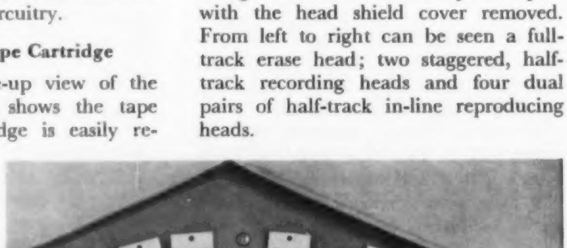

Fig. 8. Distributed Reverberation System—Magnetic Head Assembly.

Control Unit

Figure 9 is a view of the control unit which is located beneath one of the blank panels in the rack. As with the previous illustration, this particular version is designed for a system containing eight reproduce heads. Control of the first five channels is effected by the units on the upper half of the panel; and control of the remaining channels, on the lower. Each channel is provided with a separate modular unit and has four controls. The first is a three-position switch which permits the channel to be switched off completely or to be switched on with or without the associated equalization circuit. The second control which is labelled "Scramble" permits adjustment of the amount of signal cross-connected from one reproducing circuit to another. The two lower controls permit adjustment of the low- and high-frequency response of the particular reproducing circuit by approximately 12 db boost or attenuation. The "Scramble" control on the righthand corner of the panel switches in or out of circuit all interconnections between various reproducing circuits for the purpose of initial installation adjustment. The feedback control is in the lower righthand corner.

Although they are not shown in these illustrations or described in detail, the reproducing amplifiers, bias-erase oscillator and equalizer units are all transistorized modules.

Effects Reverberation System

The packaging of the reverberation system for radio or recording studio effects purposes is very similar to that shown in the above illustrations. The transport and cartridge arrangements are practically identical. However, as mentioned previously, need arises occasionally for multichannel versions for stereophonic application, in which case wider tape is employed.

Magnetic Drum Type System

An interesting application of the introduction of reverberation for effects purposes is that being used by the Ray Conniff Orchestra. The transport is shown in Fig. 10.

In this instance, portable equipment was required which could be used in conjunction with a portable sound-reinforcing system for "live" program material. To some extent, therefore, the features of the distributed reverberation system and effects reverberation system were combined. The complete system, which includes a three-channel reverberation system, was developed by Westrex Co.

The essential difference between this and the equipment which has been described previously lies in the design of the film transport and recording medium. Figure 10 is a view of this transport. It comprises an aluminum drum 5 in. in diameter driven from a synchronous motor. Magnetic oxide impregnated, neoprene belts are stretched around the periphery of the drum and a separate belt section is used for each of the three separate-information channels. The belts are each approximately $\frac{5}{8}$ in. wide and $\frac{1}{8}$ in. thick and have practically indefinite life. The neoprene belt was employed in this instance primarily because of the rugged nature required of the overall system. The equipment is required to withstand the vibration and shock occasioned by frequent transportation, and a minimum of maintenance is an absolute necessity. Other parameters, being fixed, the high-frequency response obtainable, is somewhat less than that for magnetic oxide tape; however, the response is quite adequate for this application and no compromise has been made, therefore, in overall performance. Nevertheless, care has to be taken in the mechanical and electronic design of neoprene belt type systems. The primary need for careful design considerations lies in the succeptibility of the medium to indentation and the possibility of its recording information which, owing to the thickness of the belt and consequent depth of recording in the medium, becomes difficult to erase. The former difficulty is surmounted by providing a mechanism actuated by a solenoid which retracts the heads from the belt when the power is removed or when the drum is not rotating. Provision of limiting diodes on the output of the recording amplifiers insures that high transient signals are not recorded too deeply into the medium to permit ready erasure.

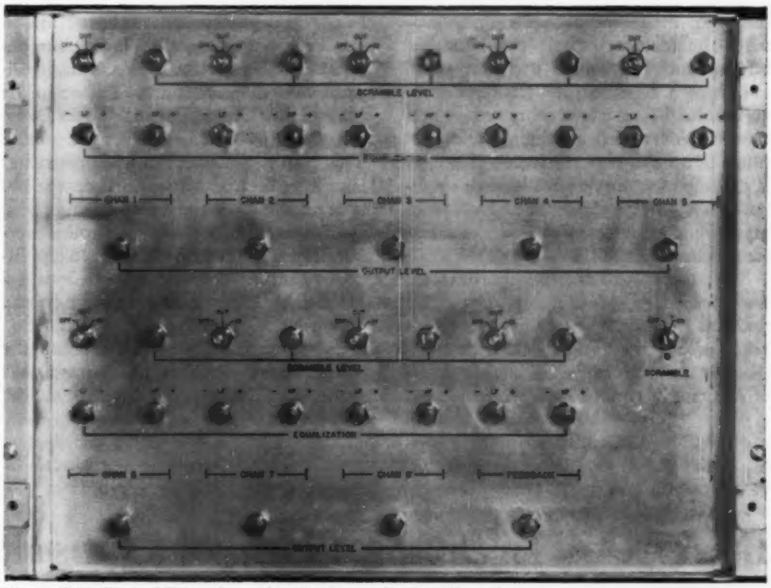

Fig. 9. Distributed Reverberation System—Control Panel.

Figure 10 shows the six banks of three magnetic heads arranged around the periphery of the drum. The head sequence is: one erase bank, one record bank and four reproducing banks. The knurled nut on the top of each bank is provided to permit adjustment of each head position around the periphery of the drum and thus permit a range of control of reverberation decay characteristic. In practice, after having initially set the head positions no further adjustment is necessary.

The electronic equipment provision within the artificial reverberation generating equipment is essentially that described in the text associated with Fig. 4. However, in addition to the recording circuit, output connection is made through a mixing control console to a multi-channel power amplifier and speaker system.

CONCLUSION

With respect to the application of the two basic versions of these systems, it will be obvious that the effects type, which is intended for broadcast and

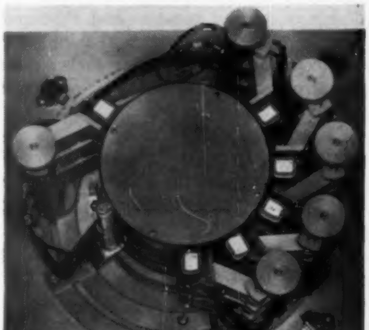

Fig. 10. Effects Reverberation System—Drum Type Transport.

film recording studio application, provides the features of an echo chamber but in much less space, at less expense and with a considerably greater degree of control. The effective reverberation time can be varied continuously over a range of up to 5 sec or more. Adjustment is provided for the relative level of reverberated to direct signal and the former may even be made to exceed the latter for special effects.

The distributed reverberation system also permits a wide range of control and has been designed to provide flexibility of circuitry and levels to accommodate a wide range of acoustic environmental conditions. This system has been demonstrated to great effect in small enclosures as well as large churches and auditoriums. Perhaps the most impressive demonstration took place in the Hall of the Crucifixion at Forest Lawn Memorial Park in Burbank, Calif. This Hall is of a most unusual design and comprises a structure approximately 100 ft deep, 200 ft wide and 50 ft high.

In this instance, the natural reverberation time was very effectively increased from approximately 2.3 to 4.5 sec to achieve particular dramatic effects.

In conclusion, we believe that the development of these equipments has made significant contributions to the state of the art particularly with respect to the distributed reverberation type. In this connection we would like to express our appreciation to Joseph S. Whiteford, Chairman of the Board of Aeolian Skinner Organ Company of Boston, Mass., for his significant contributions to the development of the distributed reverberation system.[2]

References

1. John G. Frayne and Halley Wolfe, *Elements of Sound Recording*, John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., London, 1949.
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Design of Lighting Control Consoles Used in British Television Studios

By FREDERICK P. BENTHAM

In Great Britain, lighting control has assumed great importance both as an instrument of dramatic expression and for monitoring picture quality. The lighting supervisor (director) often works the control directly without the intervention of an electrician. The quality of automatic memory derived from the inertia of electromechanical dimmer systems has simplified the design of these controls and in consequence has caused many users in Britain to be reluctant to adopt all-electric forms of dimmer such as the thyratron and silicon controlled rectifier which suggest multipreset networks.

In Britain, particularly through the pioneer "Hands Off" work of the BBC., the lighting control has assumed great importance. It is both an instrument of dramatic and artistic expression and a medium for monitoring picture quality. More often than not in Britain the lighting supervisor works the control directly without the intervention of an electrician. Except in the smallest studios the lighting controls are based on electromechanical servo-operated dimmers.

This paper explains how the quality of automatic memory derived from the inertia of such systems has simplified the design of control consoles and rendered users in Britain reluctant to adopt the all-electric forms of dimmer such as the thyratron, magnetic amplifier and the silicon controlled rectifier.

It is the author's belief, and background to all his work, that the forms of dimmer have too often influenced the control and thus complex multipreset desk networks have arisen which get between the operator and the immediate control of his lighting.

Presented on May 12, 1961, at the Society's Convention in Toronto by Frederick P. Bentham, Strand Electric & Engineering Co. Ltd., 29 King St., London W.C. 2, England.
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1. Dimmers

It is not necessary to waste space in a paper on lighting control by describing in any detail the various forms of dimmer. Dimmer systems used in the electric remote control of lighting fall into two groups: (1) all-electric and (2) electromechanical. The first consists of dimmers in which the only moving part is the dimmer operating lever. In the second, the connection between control and dimmer is electric, but through the medium of a servo. The first group subdivides as follows: saturable reactor, thyratron-controlled saturable reactor, magnetic amplifier, direct thyratron and direct silicon controlled rectifier.

There are variants of these. There is, for example, a version of saturable reactor using transistors instead of thyratrons, but the main distinction lies in whether the load is carried by a device (such as a saturable reactor) whose regulation is poor with varying load, or whether dimming is obtained by directly chopping the waveform and is therefore independent of load. In the first case, one has to depart from the basic simplicity of the reactor by applying feedback, and in the second, complications are added beyond the basic circuit owing to the need to reduce the effects of the chopped waveform as a possible source of noise and interference both electrical and mechanical.

The particular advantages claimed for an all-electric dimmer system are that (1) its nonmechanical nature fits in better with the other electronic equipment of a television studio, (2) it is more easily comprehended for day-to-day maintenance and (3) it takes up less room. The first point lacks validity; for it is a poor look-out for engineering when devices depending on an electric motor are regarded as suspect or incomprehensible. There will be fans, electric hoists and other such devices in most television studios, and electromechanical dimmer banks need be no more complicated than these. As regards space, the gain in all-electric systems is not so much the cube occupied by the actual apparatus—the smallness of silicon controlled rectifier equipment, for example, is greatly overstated — as the fact that such equipment does not depend on one complete integrated dimmer bank with access on its two major sides. Access to one side only of racks which can follow the shape of the walls allows use of irregularly shaped rooms: "the architectural leftovers." Ventilation is very simple for electromechanical dimmer banks, but electronic equipment is more touchy in this respect. Even in an all-resistance dimmer installation, the heat losses are more easily compensated for than in an all-thyratron installation. The air has merely to be withdrawn, and problems due to the drafts caused by the air being replaced do not exist.

An electromechanical dimmer bank uses either resistance or transformer dimmers or a mixture of both. It can generally be assumed that the dimmer

unit itself presents no problems, yet the fact remains that outside Britain and excluding British exports, the electromechanical systems of dimmer control have been failures. This is in spite of the fact that wholly mechanical (tracker wire) remote drive of resistances or transformer dimmers was universal on the Continent of Europe (where theater usage is at its most exacting) until recently. The truth is that the application of a remote drive other than by tracker wire is a difficult problem. Solutions outside Britain have tended to concentrate on individual reversing motors, and when these are used two main troubles are encountered — the provision of a sufficient range of speed and the prevention of hunting at intermediate positions.

In Britain, ever since the late 1920's, a solution (the Mansell clutch) has been available, and on this foundation the British style of control, which differs so radically from all others, has been built. Of this work the present writer can speak with authority because it is his own.

Each dimmer drive is taken via a pair of magnetic clutches (to give reversal) from a unidirectional motor-driven shaft common to at least half the dimmers of the installation. The motor is a relatively large compound-wound d-c geared unit, and in consequence a wide range of speed is possible: a dimmer travel of 2 sec to perhaps 1 min.

The clutch itself is a comparatively crude unit which has not departed from the basic principle since its inception. A soft iron wheel of 10-in. diameter is fixed to the shaft opposite each dimmer, and a free driving arm on one side drives a link to a crank below the dimmer pivot and another on the other side to one above, thus giving reversal. Either of the free driving arms is clamped to the driving wheel directly by an electromagnet. The electromagnet is cleared from the wheel by means of springs, although this is in fact necessary only to obviate noise and for many years was not considered a requirement. A feature of this form of clutch designed for slow-speed transmission is its instant response and lack of inertia.

The positioning of the dimmer is carried out by a bridge circuit with a polarized relay to switch in the "Raise" or "Dim" clutch according to the direction of the control current applied. The bridge circuit consists of a potentiometer moving with the dimmer and a potentiometer at the control end. The center points of each are connected through the polarized relay coil. The success of the system lies in the response of the clutch to this relay, and this response is aided by the fact that the relay contacts feed the clutch coils directly.

The actual form of dimmer, whether transformer or resistance, is immaterial as far as the design of the control desk is concerned. It is, however, of interest to remark that in Britain the light-ineffective bottom portion of a tranformer dimmer is not tracked, and wasted movement at the control lever is thereby avoided.

To sum up from the point of view of control-desk design, there is a large variety of dimmers each of which is capable of being operated from a similar remote control lever. In fact, however, there are at this moment only two classifications capable of effecting some fundamental change in design approach and those are whether the dimmer system is all-electric or electromechanical. The second system possesses a property which may be loosely described as inertia (i.e., a memory derived from its mechanical nature); the first does not.

2. Patching

It is necessary to touch on the subject of patching since it may be considered to have an effect on the design of the lighting control panel. Whether patching is carried out in the load or the control circuits does not make any difference in the context of the lighting control itself. Nor does it make much difference whether it is carried out remote from, or adjacent to, the lighting control itself.

Patching was originated for economic reasons, to keep the outlay on dimmers down. This restriction has now been distorted into a virtue, and it is claimed that patching keeps the control panel from becoming too large and allows rearrangement of circuits convenient to the operator. I consider that the first "virtue" has saved the multipreset panelists the embarrassment of confessing that they do not know what to do with all the levers their systems breed. The second virtue I concede but I do not consider that by itself it carries sufficient justification for the increased complication.

In advocating patching, one must be very careful not to restrict the number of dimmer controls in order to counter the inability at the control to house any more or, if housed, adequately to facilitate the operator's use of them.

In Europe, theaters commonly expect between 100 and 250 dimmers and in consequence the control of a large number of dimmers is a not unfamiliar problem. It is otherwise in the United States where the professional theater has with hardly an exception failed to provide a demand for a lighting control. Development there has thus been built on the patching, and a lesser number of dimmers are required for the more leisurely life of the college theater and the like. It is significant that the first of the new remote lighting controls of the postwar era in the United States, Great Britain and Germany were provided at Yale University in 1947, with 44 dimmers; at the New Theatre, London, with 144 dimmers; and at the Hamburg Opera, with 240 dimmers.

When money became available in 1955 in Great Britain to provide modern television studios and facilities, London had already two theaters with 216 remote-controlled dimmers each, one with 176, three with 152 and three with 144. Against this background it is not surprising that the first three studios for the B.B.C. should have 96, 166 and 188 dimmer channels, respectively. The average number of control channels is 120 and almost invariably these have 100% dimmers. Table I gives details for some of these studios.

Patching can be justified when the number of circuit outlets, for reasons concerned with the physical size of the studio, greatly exceeds the number of circuits ever likely to be required for a particular day's production. Such a patch panel is used to discard circuits not in use. The number of control channels likely to be able to cater for any production is provided and thus any question of squeezing circuits onto too few channels does not arise. It is important to remark that there can be patching facilities, yet no obvious patching equipment. Whereas a studio with outlets on hanging bars will need a cord and jack or equivalent unit, in many instances this exercise can be carried out in the studio itself. In Britain, the all-over grid floor above the studio, carrying point suspension telescopes, is quite common. Here the outlets spaced over the grid because of their accessibility become a kind of giant patch field.

A form of patching tried experimentally in Britain (May, 1959) should be mentioned here. This is known as shift and consists of a set of controls for dimming and switching (Fig. 1) which not only operate but can also display. Luminous controls are the most satisfactory since they can display instantly. In this case shift keys are used to connect and display, say, 100 dimmer channels. Thus at one time the controls would represent Channels 1 to 10, at another 11 to 20 or 91 to 100, for example. When displaying, the selfsame controls can instantly be used to operate. If 20 channels were displayed at one time, the shifts could probably be identified with particular scenes or scene areas on the studio floor. Channels not at present connected remain in the state to which they were last called. The control desk in the photograph can be used either to work lighting directly or to record on punch cards for recall later. Such recording not only brings back the lighting at the time the card was punched, but also the exact state of the control panel (including channels not displayed) at the time and thus modification is easy. At

Table I. Some Examples of British Television Studios Console Arrangements

Studio	Area, sq ft	Rigging	Outlets	Patching	Control	Desk†	Notes
BBC. TV. Theatre, Shepherds Bush, London	4000	Motorized bars	12 × 5K 176 × 2K	Nil	*Dimmers* 12 × 5K 176 × 2K	C	Electromechanical resistances and transformers, 2 preset
BBC. TV. Centre 3, London	8000	Motorized bars	20 × 5K 480 × 2K	Series Jack	*Dimmers* 8 × 5K 120 × 2K	C	Electromechanical transformer dimmer, 2 preset
Anglia TV. Limited, Norwich I.	3500	Grid and telescopes	6 × 5K 96 × 2K	Nil	*Dimmers* 6 × 5K 48 × 2K	CD	Electromechanical resistances, 2 preset
A.R. Wembley 5A	7000	Motorized bars	340 × 5K 8 × 10K	Series Jack	*Dimmers* 100 × 5K *Switched only* 20 × 5K 8 × 10K	CD	Electromechanical transformers, 2 preset
A.T.V. Elstree D.	9000	Grid and telescopes	10 × 10K 40 × 5K 190 × 2K	Nil	*Dimmers* 10 × 10K 40 × 5K 190 × 2K	C	Electromechanical transformers 2 preset
A.B.C. Teddington 2, London	5000	High loading grid and telescopes	2 × 10K 10 × 5K 120 × 2K	Nil	*Dimmers* 2 × 10K 10 × 5K 100 × 2K *Switched only* 20 × 2K	CD	Electromechanical transformers, 2 preset
Granada, Manchester 6	4500	Grid and telescopes	6 × 5K 94 × 2K	Nil	*Dimmers* 6 × 5K 47 × 2K *Switched only** 47 × 2K	CD	Electromechanical resistances and transformers, 2 preset

* The two new Granada studios (each 9000 sq ft) under construction will have 100% dimmers (i.e. 240 each).
† C = luminous head type. CD = stop-key type.

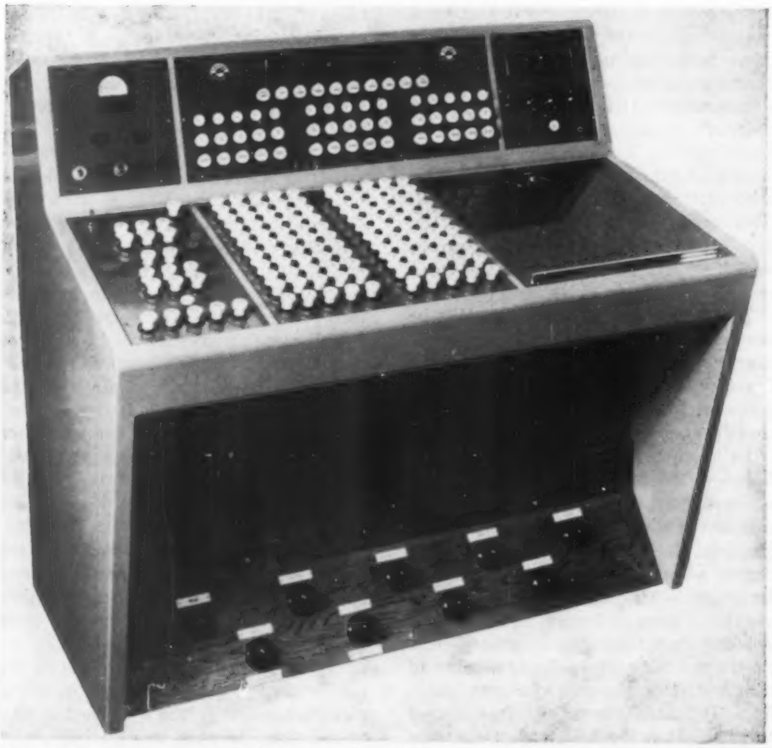


Fig. 1. Control desk using shift system of patching and display of dimmer positions on luminous controls. This panel also operates in conjunction with standard punched card recording equipment.

the present time the equipment is being converted for use with a more flexible recording system than punched cards. This system (known as K.T.V.) is mentioned here for the sake of completeness rather than its advocacy, because the initial outlay required would seem difficult to justify in a studio budget.

3. Control Consoles

It is now usual to aim at, but not always to achieve, a lighting control station for both stage or television which is capable of being operated by one man. Ideally this means all controls should be within arm's reach of an operator seated with a good view of the television monitors. Nevertheless, there are times when two operators require access to the control simultaneously. For example, in B.B.C. working, the lighting supervisor will make his own adjustments to individual dimmers to achieve the lighting balance he requires, while his assistant carries on the working of lighting cues to provide the changes required by the plot. In smaller productions one man may handle both; This also applies to larger productions during those times when the lighting supervisor is on the floor of the studio.

Figure 2 shows the arrangement adopted by the B.B.C. for studios 2, 3, 4 and 5 at their new T.V. Centre, White City. This is the complete antithesis of the practice of some studios where electricians work the lighting console, in a room completely cut off from the production center, using a solitary monitor (if they are lucky) which gives the picture on air.

To return to Fig. 2, the set of monitors shared by the lighting supervisor and the vision supervisor (who is alongside on the right but out of the picture) can be seen. Above them is a mimic diagram which follows all lighting changes and also helps to keep a direct check on patching. On either side within arm's reach are the dimming and switching wings for 138 dimmer channels with a view over the left wing into the producer's control room. Figure 3 shows the same type of control layout enlarged to control 240 dimmer channels as for each of A.T.V's Elstree Studios, C and D.

Fig. 2. Lighting control in BBC Television Centre Studio 3. Dimmer controls and channel selectors are on the left and right with master controls and memory pushes on center table. Mimic diagram is overhead. Producers room on the left and Vision Supervisor alongside of the right.

Another form of console (Fig. 4) popular in Great Britain proclaims more clearly its relationship to the organ. This example is from A.R.'s Studio 5, Wembley, where electrician working is practiced, but other studios such as A.B.C. at Teddington and Granada, Manchester, use this form of console for lighting supervisor operation.

All the above consoles use electromechanical operated transformer dimmer banks. Indeed, it is only because such are used that these consoles are possible at the present stage of control development. There now follows an investigation of the basis of this claim.

3.1. Size of Controls

The use of miniaturized controls is condemned in this paper and this prompts the inevitable question as to what size the present writer recommends. There is little difference whether a dimmer lever or a switch is in question, both are for finger operation.

Fig. 3. 240 Channel lighting control as in ATV Elstree Studios C & D.

Fig. 4. Organ type lighting control in AR Wembley Studios 5A & 5B.

Bearing in mind that the control unit should form its own labeling (otherwise any space gained is squandered and there is also a risk of confusion), a limit is already set on size-legibility in poor lighting. However, the real problem is finger size, especially in rapid work at an angle when reaching out to a control. The width from center to center of piano keys is $\frac{15}{16}$ in. and of typewriter keys $\frac{3}{4}$ in. Similar centers prevail for organ stopkeys. It would seem that departure from centers of just under 1 in. would be ill advised.

A dimmer lever is best constructed as a finger lever alongside a fixed and raised quadrant scale. Such fixed scales give comforting visual and physical landmarks among a sea of moving parts (levers). I dislike the type where the scale, lever and all moves, and even more the type where the scale is only partially displayed. Where fixed scales are used, the dimmer levers can be mounted in pairs, one either side of the quadrant they share. Thus dimmer lever centers are reduced to $\frac{3}{4}$ in. Color can be a great help to define particular blocks of levers and give visual landmarks to help find one's way around. It seems to the writer, however, that color is often used to give coding on individual knobs in such a way as to provide dazzle for the eye, rather than help, however symbolic it may all be. White engraved on black should seldom be used because legibility deteriorates.

4. Control Networks for All-Electric Dimmers

As stated earlier, it is a feature of all-electric dimmers that they must be energized with control current in order to hold any condition other than "light out." It follows, therefore, that a control lever working a potentiometer (or equivalent) will be needed for every dimmer to be operational at the control panel.

4.1 Presetting

In order that a series of lighting channels may be preset to levels differing from those already in use, two sets of control levers are required, i.e., a pair for each channel. The two series can be connected to either side of a cross-fader or fed each from its own fader. The latter arrangement is preferable because then one is not restricted to direct cross-fades and because both could be used together, i.e., piled. The BBC. operators prefer to have the pair of presets for each channel mounted side by side to facilitate matching. I prefer, however, to place presets as alternate rows one above each other as in Figs. 4 and 5. Such an arrangement still allows matching but does avoid the need to dodge the other preset when "playing" lighting.

4.2. Multipreset

There is no reason why the control should be restricted to mere duplication of dimmer levers, and 10 preset installations are well known, though no one seems prepared to go above this number (or 11, see below) unless a radical change in the system, such as using punch cards is invoked.

For a 100-channel 10-preset installation, 1000 control levers are required. Perhaps 1000 control levers is the limit sanity will tolerate. Personally, my limit comes long before this. The more dimmer levers, the more difficult they are to house. Where (as is often the case) a set of dimmer levers — the rehearsal system — sufficiently large to allow gracious and accurate control is provided, then the precise levels arrived at using these cannot easily be matched on the miniature (of necessity) levers provided for so many presets.

The reason for the large number of presets, at any rate in television, is not so much that many changes of level, other than to zero, are required in respect of each individual circuit for a production, as that such levels have to be used combinationally in several ways with other equipment (see below). To this has to be added the wasteful effect of using dimmer levers to take lights out, to cut lighting in unwanted areas.

4.3. Selection for Operation

At a particular moment the operator may be concerned with one channel or a group of several channels, or the lighting of an entire scene area, or perhaps only with a particular effect on one area. To rely on dimmer levers for this selection is wasteful, nor can a dimmer lever be as quick to operate as some form of on-off switch.

For simple control panels this selection can be provided for by a three-position switch to form three groups. Thus in Fig. 5 the two preset dimmer levers to each channel are mounted one over the other and above these are two three-position switches. The lower of these switches in its top position causes the presets to be mastered from the top pair of preset faders; in the bottom position, from the bottom pair; and in the center position, from the center pair. Thus, although there are only two dimmer levers to each channel, six specific lighting changes can be set in advance. In fact, in the control shown, the other switch gives further groupings.

In some United States examples, choice can be made from as many as eight groups plus a further independent or rehearsal bar. The trouble with these more complex systems is that they breed controls. A system having ten dimmer levers, plus eight group-selector buttons and a "Preset/Rehearsal" switch, all for each dimmer channel, together with the mass of master faders associated, lends itself neither to ready and instant appraisal nor to rapid setting up. This is even more important in the theater proper where resetting of the control several times would be bound to be

Fig. 5. All-electric control desk. 2 sets of dimmer levers with grouping tablet switches providing connections to the six masters on the right.

necessary during a performance — large numbers of lighting changes being common in today's staging.

The amount of lighting changes in television varies very much. Light entertainment requires many such changes as a matter of course; drama, very few except in the kind of mystery drama in which the characters are perpetually going in and out of rooms and switching the lights on and off. All these are quick switching or cross-fade cues, i.e., roughly half the channels are likely to be cut or faded to out. As regards the balancing of levels for individual dimmer channels, B.B.C. and other experience in Britain seems to show two presets (at the most three) as enough. Unfortunately, where all-electric dimmers are concerned, this may lead to the provision of more than two or three levers per dimmer in order to take care of the combinational effect of the several scenes or areas of a scene.

When both presets and groups are taken into account, the master controls for them become so numerous as to form in effect a switchboard in themselves. Circuits are patched to channels and by one means or another these are in effect patched to masters, a complicated network of variables being established for one production only. Is there a simpler way of doing things? To this the answer is "Yes, provided electromechanical dimmer systems are used." It is the British television practice in this respect that forms the subject of the remainder of this paper.

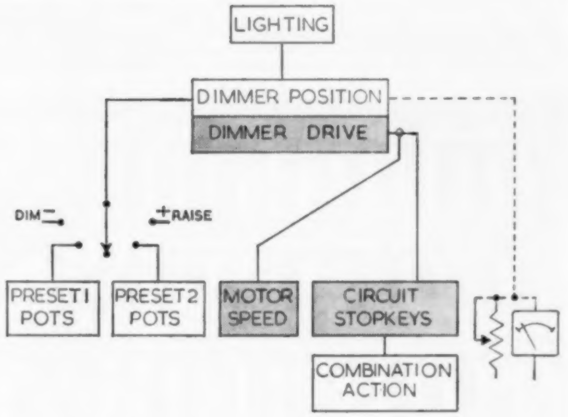


Fig. 6. Schematic of electro-mechanical dimmer control system showing the positioning servo in white and the selection for drive shaded.

5. Control Systems for Electromechanical Dimmers

It is important to bear in mind that control consoles for electromechanical dimmer banks can be designed solely to provide changes of lighting; they need play no part in the maintenance of the status quo. In this lies great opportunity but also a trap. To give a simple example: one set of dimmer levers can provide a preset ahead of the lighting in use because these levers need not be tied up to hold it. Dimmers once driven to the requisite levels can be left to look after themselves. The trap is, of course, that the operator may no longer know the exact position of a dimmer, because its control lever has since been moved. To overcome this, all controls of the type which follow are always provided with a circuit to display on a dial the exact position of each dimmer. In some systems, this indication is provided automatically every time a channel selector is touched; in others it is made available at a heavier (second) touch.

For the purpose of this paper it will be better to confine the description to the organ type of console which appears in Fig. 4 rather than the forms shown in Figs. 2 and 3 (see Sect. 5.2 below). However, it is the basic principle which needs to be established and this can best be shown in the organ type of console. Incidentally, this type is far commoner than any other in British television studios and theatres.

Figure 6 shows the schematic basis of the organ form of control. Because the dimmers are driven through an electromechanical servo, they require both positioning instruction and drive instruction, as shown at the top of the diagram, before they will change. Positioning they receive from either of the two preset levers (a pair per channel) shown on the left. Incidentally, it will be noticed that when an intermediate level is not required, they can receive this positioning in the form of positive, to drive dimmers up, or negative to drive dimmers down. This is in fact provided by putting down the console lever network to positive or negative directly, thus nullifying the effect of lever positions.

Dimmers will not move merely by being connected to the controls on the left; they also need drive current, which is obtained through the selectors shown shaded on the right. These selectors for convenience take the form of organ stopkeys. The stopkeys themselves are fitted with electromechanical on-off action so that they can either be directly operated by hand or captured on a memory system — shown on the diagram — to be brought in as groups by pressing a single button.

In the close-up photograph, Fig. 7, the pairs of preset levers mounted one above the other can be seen, and along the top the stopkeys to select those circuits which are to move. Under the stopkeys to the right can be seen the memory buttons which can be made to move the selected groups of stopkeys when hand operation is inconvenient. Master controls become very few in number, as the small righthand panel underneath the memory buttons shows. On this there is a "Raise" button to provide this result without having to set dimmer levers, and a "Dim" button for this purpose. There are the two preset buttons, usually identified as "White Preset" and "Green Preset" (dimmer lever scales are tinted), and "Pilot Lighting" to indicate which was last used. Under all these are the two buttons to switch "on" and "off" circuits.

In addition, the panel contains the master dimmer, which can be used to effect a proportional cut on any selected circuits, and the individual dimmer which can be used in conjunction with a second heavy temporary touch on any stopkey to modify that particular channel without disturbing the preset network; the same touch also gives the reading of the dimmer position, as mentioned above. There are two further controls which do not appear in the picture, namely the balanced speed pedal to determine the rate of dimmer travel, which has a light indicator on the panel above, and the "Remainder Dim," a master push for foot operation which is described later on. Most of the master controls on the righthand panel are in fact duplicated for foot operation.

5.1. Method of Operation

It is now possible to consider the actual working of the control. Circuits are selected by putting down the stopkeys by hand or by putting down a previously preselected combination by using one of the memory pushes. These circuits can now be switched on by touching the "Go" button and will remain on until definite action is taken to put them off. Mere knocking off the

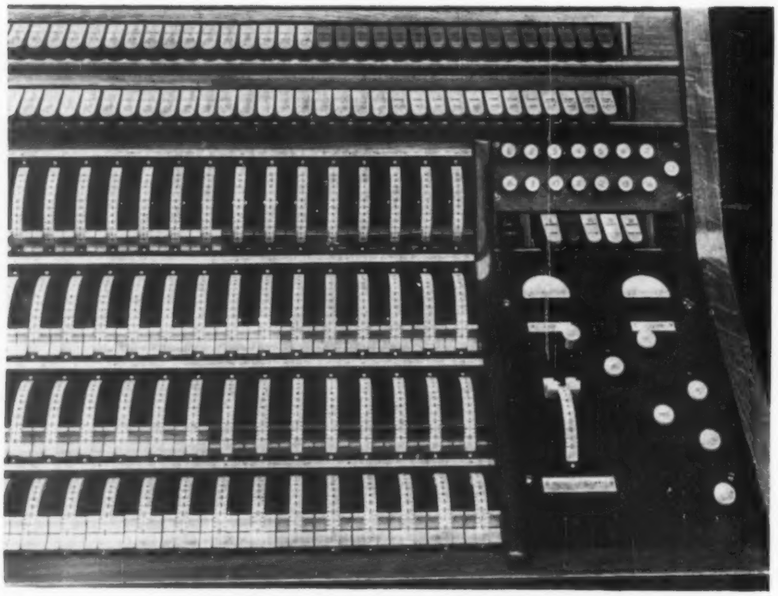


Fig. 7. Close-up of control on organ console type of desk. Channel selection by stop-keys overhead, positioning from two sets of dimmer levers on the left and master unit including memory pushes on the right.

selector stopkeys will have no effect in this respect. The whole basis of this control, as has been said repeatedly, is that lighting stays as it is until something is deliberately done to change it. This deliberate action always involves selection of the channels in question and the use of an appropriate master. Neither operation by itself has any effect. This is the procedure whether one or many channels are in question.

Dimmers for the selected circuits may now be raised to full by using the "Raise" button. They may even be raised to three quarters by releasing the "Raise" button as the indicator dial passes that mark. However, when intermediate positions are concerned, it is customary to make use of one or the other of the two presets. In many instances in Britain these preset levers are set at the beginning of the day at 7 or 8, i.e., 70 or 80%, and then moved either downward to decrease the light or upward to increase the light to suit the balance required. Once the particular group has been settled, one can move on to the next merely by pressing the appropriate memory button. The lighting just set up will remain locked on in the studio until reselected for something further to be done with it. Selection by stopkey is the invariable rule and, for example, when the master dimmer is required, this will apply only to circuits whose stopkeys have been selected.

A feature of the use of stopkeys is that they give a very positive indication, as the photograph shows, whether they are selected or not, and any use of the memory action also gives this positive action because it moves the stopkeys themselves.

Switching cuts from one group to another are readily possible by selecting the second group, pressing the switching "Go" master, whereupon the second group is brought on, and then pressing a "Trip" button which takes out the previous combination. The delay between using one button and the other will determine the amount of lag in the switching changeover. "Remainder Dim," mentioned above, provides a similar effect in respect to dimming. When a group is being brought in by use of the "Raise" button or either of the "Preset" buttons, the foot can be placed on "Remainder Dim" to fade out all channels not at that time selected, thus giving a cross-fade.

5.2. Other Developments

The elementary system has been described in detail as being more easily understood. The few controls involved speak for themselves in the photograph (Fig. 7). It is of course possible to go further than this; for example, it is not necessary, although it is usually convenient, to make use of the exact console form. There are under construction installations of 120 and 240 channels which use a center table for the Masters and for the lighting supervisor's plots, and which have speed pedals and food controls located beneath this table. The dimmer controls and stopkeys themselves are mounted on vertical wings at the righthand side of the operator. Such an arrangement may fit in more conveniently with the layout of a control room. Furthermore, it may permit, when required, the use of two operators rather than one.

For installations of this wing type, however, it is usually preferred, where funds permit, to use a luminous head as selector in place of the stopkey. In this case, selection is indicated by the head lighting internally. This is the system used for the BBC. and Elstree in Figs. 2 and 3. Luminous heads are not quite so convenient to operate as stopkeys since the fingers cannot run along them or under them so readily. Also they breed rather more complicated relay systems because the on and off mechanism is not integral in them. However a luminous head with a lamp does allow us to use the head to show more than one thing at a time. Thus it is possible to indicate at the head normally the circuits selected for action, but the touch of a button at Elstree, for example, turns the indication given by the head to an indication of those circuits actually alight in the studio. This is done by touching a single push, and when this push is released the heads return to their indication of the circuits selected. This is merely reading the state of the controls and does not interfere with them at any time, studio lights remaining alight, even when not indicated. One can tell which indication is being given at the luminous heads in two ways: first, the normal indication is of selection, and unless one's foot is pressing a particular control this will be what is displayed. The operator has to decide when he wants to display the indication of the studio lighting. Thus there is no risk of confusion. Second, as an added safeguard a green pilot light shows at the end of each row of luminous heads.

The BBC. operators, however, prefer to use a separate lamp indication and thus, adjacent to the luminous head, there is a small green pilot to give the second indication. In this case, circuits selected show on the green pilots and circuits switched on in the studio show in the luminous heads. They also have a further indication, i.e., the exact state of dim at the mimic diagram. This latter may be regarded purely as a check of the state of patching, there being a lamp for every studio outlet.

Luminous head installations operate through reverser relay systems, there being one reverser for the circuit switch and another for the dimmer selection. These reversers are in turn taken to the normal memory action, but it is customary to provide more memories when luminous heads are provided since, as explained earlier, they do not handle manually as well as stopkeys.

It will be appreciated that selection may be used to operate some dimmers out of a group of circuits switched on.

Thus in light entertainment a cross-fade may take place between lights within a particular group. It is at times undesirable that such a cross-fade using "Remainder Dim" should in fact take all dimmers down except those at that moment selected. A modification which is available uses luminous heads and enables a cross-fade to take place between the circuits selected and those not selected, but the latter are restricted to those circuits actually alight in the studio at that moment. There is in this case no risk that the dimmers in areas to which we wish to switch later are being run down on "Remainder Dim."

6. Conclusions

It will by now be obvious that these control systems based on electromechanical dimmer banks are quite different from any other systems, and present remarkable advantages in respect to simplification of mastering and yet provide a high degree of versatility. It is not, however, the object of this paper to claim for these controls the ability to do everything. Such extravagant claims all too often appear for this and that dimmer or this and that control system. In my view the perfect control is far away as yet, and may never be a commercial proposition, but naturally one continues to experiment to provide it. Obviously a mechanical dimmer bank presents certain disadvantages, particularly where dimmer rooms are small and irregularly shaped. To get the best out of such an electromechanical system, it ought to have a full set of transformer dimmers, although it would be a pity if such a dimmer were to restrict the outlay available for the control itself. A happy situation is often a mixture of resistance dimmers and transformer dimmers, say 75% of the former and 25% of the latter. However, it must be remarked that installations such as that of the BBC. and of A.T.V. at Elstree, and A.B.C. Teddington, are 100% transformers.

A particular drawback to an electromechanical system is of course the product of its very advantage, namely the inertia. It is obviously not possible to obtain the instant cut of level in respect to circuits in use that one can secure in an all-electric system. Furthermore, the system does depend for its practical application on one motor driving a whole dimmer bank, and this means that the operator has to be content with all his dimmers moving at the same speed and at the same time. It is possible for a good operator to juggle the controls, selecting first this memory group and then another, while operating the foot pedal with the skill normal to a car driver, to provide a slow-moving group of lighting against a fast-moving one. Nevertheless, the fastest speed one can legitimately expect would be not less than 2 sec or more often 3 sec. Slow speeds give no trouble since direct drive takes us down to about three-quarters of a minute for dimmer travel, and an impulse device can be fitted for speeds slower than that. However, such slow speeds belong to the theater and not television. It would be very nice to combine in one control the instantaneous nature of all-electric systems with the inertia effect of electromechanical systems; but unfortunately this is not possible at present, and when it is, may involve us in outlandish expenditure. Meantime, in Britain at any rate, in balancing the advantages of an all-electric system and its drawbacks with the advantages and drawbacks of an electromechanical system, the consensus is for the latter. That this is really and truly believed and not just a claim is surely shown by the fact that all the larger studios use the latter system.

A Transistor Synchronizing Signal Generator

By J. S. MYLES and J. N. REID

A sync generator which uses only semiconductors as amplifying or switching devices is described. The standard EIA outputs are formed by a unique method of pulse selection from a single pulse train and the start and duration of each portion of these waveforms has a precise time relation to the originating pulse train. Examples of the circuit design are given and some of the electrical and mechanical features are discussed. The design methods described have been used in a sync generator having the assigned type number R20861A.

THE SYNCHRONIZING SIGNAL GENERATOR is an important piece of equipment in television studio and field operations. The generator must produce four basic outputs[1]:

(a) a composite sync signal comprised of horizontal sync pulses, equalizing pulses and vertical sync pulses;
(b) a composite blanking signal comprised of horizontal blank and vertical blank pulses;
(c) a horizontal driving signal; and
(d) a vertical driving signal.

In the generator to be described, the composite waveforms are formed by selecting the appropriate groups of pulses from continuous trains of horizontal sync pulses, vertical sync pulses, etc. The formation of the composite waveforms and the generation of the selecting waveforms will be described with reference to Fig. 1, a block diagram of the generator, and to Fig. 2, a timing diagram of the generator waveforms.

I. BLOCK DIAGRAM DESCRIPTION

A. Frequency Countdown

The standard sync generator waveforms are derived from a 31.5-kc/sec pulse train having a rise time of approximately 0.1 microsecond (μsec). This pulse train is represented by waveform 1 on Fig. 2.

The 31.5-kc/sec trigger pulse train is applied to each of three countdown monostables which provide a frequency division of 3, 5 and 7. The output of these counters is represented by waveforms 2, 3 and 4, respectively, on Fig. 2. The counters produce pulses which are somewhat less than 30 μsec wide and are used for the selection of particular trigger pulses from the 31.5-kc/sec pulse train 1. The outputs of the $\div$ 3, $\div$ 5 and $\div$ 7 counters are applied to a coincidence circuit which produces an output once every $3 \times 5 \times 7 = 105$ periods of the 31.5-kc/sec source. The coincidence of the $\div$ 3, $\div$ 5 and $\div$ 7 counters is shown as waveform 5. The output of this coincidence circuit and pulse train 1 are applied to another coincidence circuit which selects every 105th pulse in waveform 1. The pulse selected by this coincidence is used to trigger a second $\div$ 5 monostable counter. This counter produces an output pulse for every 525 pulses in the 31.5-kc/sec pulse train and is the lowest frequency counter used in the generator, 60 pulses/-sec output. The output pulse is approximately 3 millisecond (msec) and is represented by waveform 6.

B. Formation of the Basic Pulse Waveforms

As previously mentioned, the horizontal, equalizing, vertical sync and horizontal blanking pulses are continuously generated.

Between the master oscillator and these generators there is an adjustable time delay provided by a conventional delay line. The delay line is used to provide a delay equal to 0.02 H, minimum, between the beginning of the horizontal blank pulse and the horizontal sync pulse, and to provide an adjustable delay of 0.0 H to 0.05 H minimum between the sync and video signals to account for cable delay of the blanking, drive and video signals.

The symbol H refers to the horizontal period of 63.5 μsec and V whenever used refers to the vertical period of 16.7 msec.

The horizontal sync pulses are generated by a 15.75-kc/sec pulse train which is formed by selecting alternate pulses from the delayed 31.5-kc/sec pulse train. Selection is made by a coincidence circuit which has the delayed 31.5-kc/sec pulse train as one input and the output of a $\div$ 2 counter as the other input. The 15.75-kc/sec pulse train produced by this selection is used to trigger a blocking oscillator which produces a pulse with a nominal width of 0.075 H. This pulse train is represented by waveform 19 on Fig. 2.

The equalizing pulses are generated by the delayed 31.5-kc/sec pulse train in a blocking oscillator which produces a pulse 0.034 H to 0.037 H wide. This pulse train is represented by waveform 20 on Fig. 2.

The vertical sync pulses are generated by the delayed 31.5-kc/sec pulse train in a monostable multivibrator producing a pulse length of 0.43 H, nominal. This pulse train is represented by waveform 21 on Fig. 2.

The horizontal blanking pulses are generated by a 15.75-kc/sec pulse train which is formed by selecting every other pulse from the 31.5-kc/sec pulse train. This selection is again made by a coincidence circuit which has the 31.5-kc/sec pulse train as one input and the output of the $\div$ 2 counter as the other input. The same selecting waveform is used for both the horizontal sync pulse triggers and the horizontal blanking triggers; hence the horizontal sync and blank cannot be generated out of step. The horizontal blank pulses are generated in a blocking oscillator and are indicated on Fig. 2 as part of the composite blanking waveform 23.

To form the composite sync waveform, a group of 9 horizontal sync pulses must be removed from waveform 19, a group of 6 equalizing pulses inserted from waveform 20, then a group of 6 vertical sync pulses inserted from waveform 21 and finally another group of 6 equalizing pulses from waveform 20. To form the composite blanking waveform, approximately 20 horizontal blanking pulses are removed from the continuous pulse train and the vertical blanking pulse is inserted. The generation of the selection waveforms which perform these functions will be described.

C. Selecting Waveforms

The use of selecting waveforms for the formation of the composite waveforms has been described by Welsh.[2] The method outlined below is similar to that used in the reference except that changes have been made to conform to present standards.

The selection waveform which removes the 9 horizontal sync pulses is generated in a bistable multivibrator referred to on Fig. 1 as the equalizing pulse and horizontal sync pulse group gate generator. The name is derived from the fact that the voltage waveform from one side of the flip-flop is used to select 18 equalizing pulses and that from the other side is used to remove 9 sync pulses from the continuous train leaving the horizontal sync pulse generator.

Presented on May 12, 1961, at the Society's Convention in Toronto by J. S. Myles and J. N. Reid (who read the paper), Research and Development Laboratories, Northern Electric Co., Ltd., P.O. Box 3511, Station C, Ottawa, Ont.
(This paper was received on May 8, 1961.)

The first trigger pulse into this gate generator after the zero time reference shown on Fig. 1 is the 0 + 3 pulse. This pulse is selected as follows:

(a) The output of second ÷ 5 countdown monostable (waveform 6), the output of the ÷ 3, ÷ 5, ÷ 7 coincidence circuit (waveform 5), and the 31.5-kc/-sec pulse train (waveform 1) are used as inputs to a coincidence circuit which selects the 0 pulse from the 31.5-kc/sec pulse train.

(b) The 0 pulse is used to trigger a monostable which generates a pulse about 1.5 periods long. The trailing edge of this pulse is used to generate the 0 + 3 gate which has a duration of about 3 periods. This gate is represented by waveform 7 on Fig. 2.

(c) The output of the ÷ 3 monostable (waveform 2) and the output of the 0 + 3 gate generator are inputs to a coincidence circuit termed the 0 + 3 gate selector which produces an output pulse about 30 μsec wide centered about the 0 + 3 pulse.

(d) This gate pulse and the 31.5-kc/-sec pulse train are inputs to a coincidence circuit called the 0 + 3 pulse selector, the output of which is the 0 + 3 pulse, represented by waveform 8.

The next trigger pulse into the equalizing pulse group gate generator is the 0 + 21 pulse which is selected as follows:

(a) The output of the ÷ 3 and ÷ 7 countdown monostables are connected to a coincidence circuit, the 0 + 21 gate generator.

(b) The 0 + 21 gate and the 31.5-kc/-sec pulse train are connected to another coincidence circuit, the 0 + 21 pulse selector, which selects every 21st pulse from the 31.5-kc/sec pulse train. The 0 + 21 pulse resets the equalizing pulse group gate generator, and the 0 + 42, 0 + 63, etc., pulses which are subsequently selected have no effect.

This pulse train is represented by waveform 9. The voltage waveforms at the two collectors of this gate generator are represented by waveforms 10 and 11 of Fig. 2.

Waveform 10 and the horizontal sync pulses are used as inputs to a coincidence circuit termed the horizontal sync pulse group selector. The output of this selector is a train of horizontal sync pulses with groups of 9 pulses removed every $^1/_{60}$ sec.

Waveform 11 and the equalizing pulses are used as inputs to a coincidence circuit called the equalizing pulse group selector. The output of this selector is a group of 18 equalizing pulses which recurs every $^1/_{60}$ sec.

It should be noted that because of the small time delay between the trigger pulses used to generate the gating waveforms and the trigger pulses used to

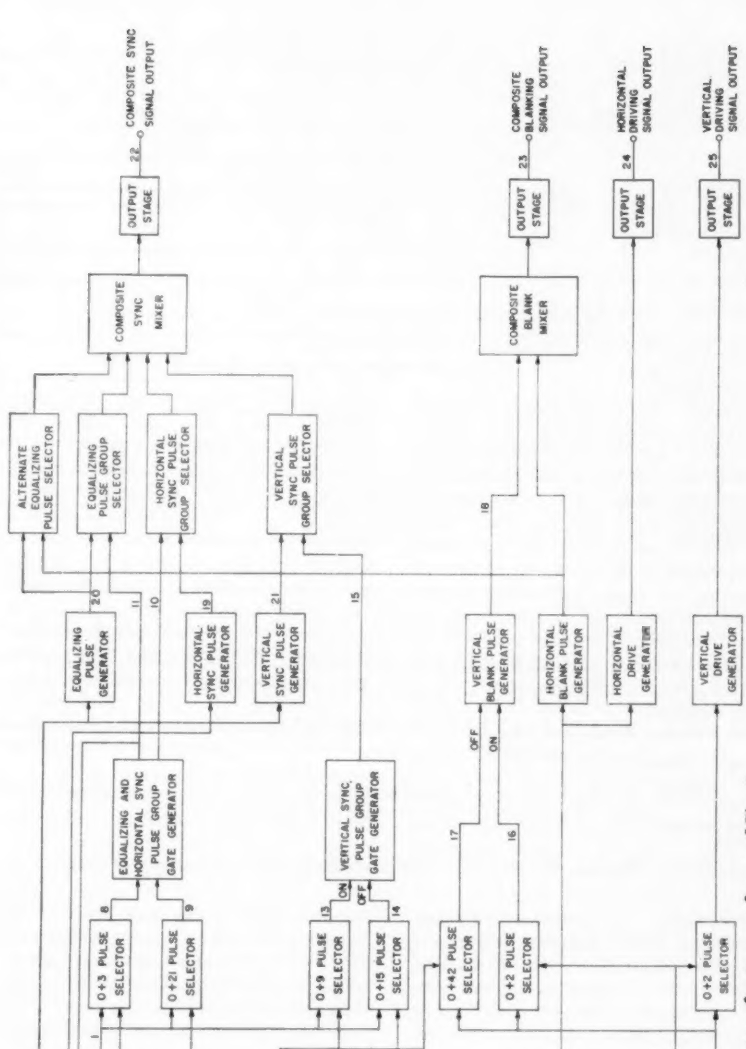


Fig. 1. Block diagram of basic sync generator. Numbers on connecting lines refer to waveforms of Fig. 2.

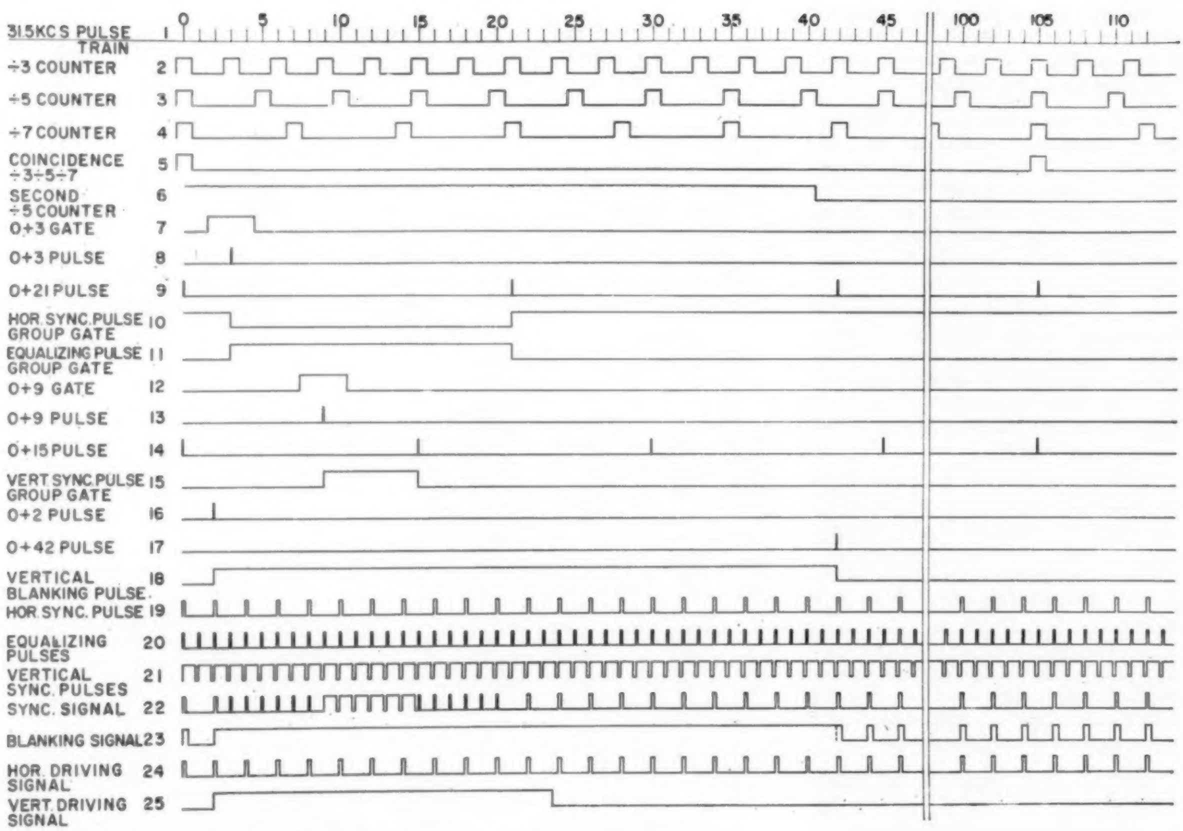


Fig. 2. Timing diagram showing formation of standard sync generator waveforms.

generate the sync pulses, the gating waveforms begin slightly before the first to be excluded (or included) and end slightly before the next pulse which is to be included (or excluded) and there is no distortion of the excluded or selected pulses by the grating waveforms.

The selection waveform which picks out 6 vertical sync pulses from the 31.5-kc/sec train of vertical sync pulses is generated in a bistable multivibrator referred to on Fig. 1 as the vertical sync pulse group gate generator. This gate generator is turned on by the 0 + 9 pulse and turned off by the 0 + 15 pulse as follows:

(a) The trailing edge of the 0 + 3 gate pulse is used to generate a pulse which is about three periods long, with the trailing edge occurring between the 0 + 7 and 0 + 8 pulses. The trailing edge of this pulse is similarly used to generate another pulse about three periods in duration which is centered about the 0 + 9 pulse. This pulse is called the 0 + 9 gate and is shown on Fig. 2 as waveform 12.

(b) The 0 + 9 gate pulse and the output of the ÷ 3 countdown monostable are used as inputs to a coincidence circuit called the 0 + 9 gate selector, which produces an output pulse about 30 μsec wide centered about the 0 + 9 pulse. The gate pulse from this selector and the 31.5-kc/sec pulse train are used as inputs to another coincidence circuit, the 0 + 9 pulse selector, the output of which is the 0 + 9 pulse. This pulse is shown as waveform 13, and is the turn-on pulse for the vertical sync pulse group gate generator.

(c) The turn-off pulse for this gate generator is the 0 + 15 pulse which is selected with the coincidence of the ÷ 3, and ÷ 5 countdown pulses in the 0 + 15 gate generator. The output of the 0 + 15 gate generator and the 31.5-kc/sec pulse train are used as inputs to the 0 + 15 pulse selector. The output of this pulse selector is the pulse train represented by waveform 14. The 0 + 15 pulse resets the vertical sync pulse group gate generator and the 0 + 30, 0 + 45, etc., pulses have no effect.

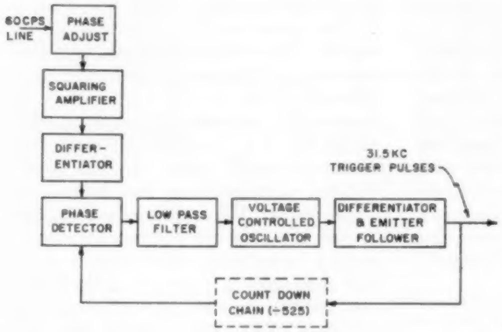
The resulting vertical sync pulse group gate, waveform 15, and the 31.5-kc/sec vertical sync pulse train are applied to the vertical sync pulse group selector, a coincidence circuit, the output of which is a group of 6 vertical sync pulses, the groups recurring every 1/60 sec.

On Fig. 1 it can be seen that there are four inputs to the composite sync mixer. Three of these have been discussed, i.e., the output of the vertical sync pulse group selector, the equalizing pulse group selector and the horizontal sync pulse selector. The additional input is from an alternate equalizing pulse selector. The equalizing pulses have been designed to have a slightly shorter rise time than the other sync components, and the purpose of inserting alternate equalizing pulses into the mixer is to ensure that the leading edges of all the sync pulse components are uniformly spaced in time. The alternate equalizing pulses are selected by using the horizontal blanking pulses as the selecting waveform for this coincidence circuit.

D. Synthesis of the Composite Sync Waveform

The composite sync mixer is formed by four common collector stages having a common load resistor (see Fig. 8). The voltage swing out of each of the four pulse selectors is approximately equal to the maximum voltage swing across the common load resistor, and so the circuit performs both as an adder and a limiter. The outputs of the four selectors are combined as follows.

Out of the horizontal sync pulse selector there is a train of sync pulses with a group of 9 pulses missing, the breaks in the pulse train occurring every 1/60 sec. During the period when horizontal sync pulses from the selector are entering the mixer, there is no output from the equalizing pulse or the vertical sync pulse group selectors, and the out-



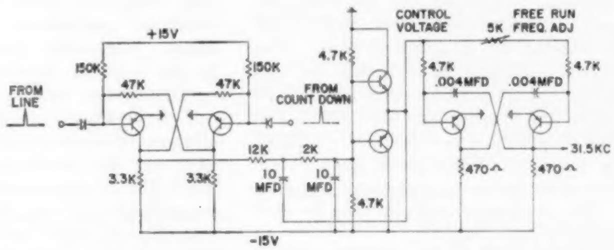


Fig. 4. Schematic of the phase detector, filter and voltage-controlled oscillator used for 60-cps line lock.

Fig. 3. Block diagram of line-lock circuitry.

put from the mixer during this period is the 15.75-kc/sec horizontal sync pulse train.

The period during which 9 horizontal sync pulses are missing is equivalent to 18 intervals of the 31.5-kc/sec trigger pulse train, and into this 18-interval period are inserted 6 equalizing pulses, 6 vertical sync pulses and another 6 equalizing pulses.

During the 6 intervals of time following the entry of the last horizontal sync pulse, the first 6 equalizing pulses are entering the mixer from the equalizing pulse group selector. During this time there is no output from the vertical sync pulse selector or the horizontal sync pulse selector, and the output of the mixer is the 6 equalizing pulses.

During the next 6 intervals both equalizing pulses and vertical sync pulses are entering the mixer but because of limiting the pulses do not linearly add and the output of the mixer appears as 6 vertical sync pulses which have a small amplitude pedestal on the leading edge caused by the equalizing pulses. As was previously mentioned, the alternate equalizing pulses are also added in the mixer, and these cause a similar small amplitude pedestal on the leading edge of the horizontal sync pulses.

During the last 6 intervals of the 18-interval break in the horizontal sync pulse train, there is no output from the vertical sync pulse selector, and the output of the mixer is the trailing group of 6 equalizing pulses.

After mixing, the composite waveform is clipped and squared before going to the output stages. The resulting composite sync waveform 22 is seen in Fig. 2.

E. Synthesis of the Composite Blank Waveform

The generation of the horizontal blanking pulses has been previously described. The vertical blanking pulse is the only other input to the composite blanking mixer and its generation will be outlined.

The vertical blanking pulse must begin 3.025 H ($+H$, -0) before the start of the vertical sync pulses and end from 15 H to 18 H after the start of the vertical sync pulses. The vertical blanking pulse has been chosen to start with the $0 + 2$ pulse, since this pulse occurs close to the middle of the allowable tolerance on the leading edge, and to end with the $0 + 42$ pulse, since this pulse occurs close to the middle of the allowable tolerance on the trailing edge. The $0 + 2$ pulse is selected as follows.

The 0 pulse is stretched to approximately 1.5 intervals and the trailing edge of this pulse is used to generate the $0 + 2$ gate pulse, which has a duration of about 30 μsec and is centered in time about the $0 + 2$ pulse. The $0 + 2$ gate pulse and the 31.5-kc/sec pulse train are the inputs to the $0 + 2$ pulse selector, and the resulting output, shown as waveform 16, is the $0 + 2$ pulse.

The $0 + 42$ pulse is selected as follows. The trailing edge of the equalizing pulse group gate is used to generate a pulse which has a duration of about 17 intervals. The trailing edge of this pulse is used to generate another pulse, called the $0 + 42$ gate, which has a duration of approximately 8 intervals and is centered in time about the $0 + 42$ pulse. The $0 + 42$ gate forms one input of the $0 + 42$ gate selector, the other two inputs being the outputs of the $\div$ 3 and $\div$ 7 countdown monostables. The output of this selector is the $0 + 42$ gate pulse, which is about 30 μsec wide and is centered about the $0 + 42$ pulse. The $0 + 42$ gate pulse and the 31.5-kc/sec pulse train are inputs to the $0 + 42$ pulse selector, the output of which is the $0 + 42$ pulse, shown as waveform 17.

The $0 + 2$ pulse is used to trigger a bistable multivibrator which forms the vertical blanking pulse generator, and the $0 + 42$ pulse is used to reset this flip-flop. The resulting output pulse of the generator is shown as waveform 18.

The composite blanking mixer is similar to the sync mixer except that it uses two grounded collector stages with a common load. The 15.75-kc/sec horizontal blanking pulse train and the vertical blanking pulses are combined in the mixer, and the output is clipped and squared before application to the output stages. The resulting composite blanking waveform 23 is shown on Fig. 2.

F. Generation of the Horizontal and Vertical Driving Signals

The horizontal driving pulses are generated in a blocking oscillator triggered by a 15.75-kc/sec pulse train. The 15.75-kc/sec trigger pulses are produced by the selection of alternate pulses from the 31.5-kc/sec pulse train in a coincidence circuit fed with the 31.5-kc/sec pulse train and the output of the $\div$ 2 counter. This is the same counter that is used for the selection of the alternate trigger pulses which go to the horizontal sync pulse and the horizontal blank pulse generators; hence all these pulse trains are generated in step. The horizontal drive pulses are clipped and squared before application to the output stage and the resulting pulse train is represented by waveform 24.

The vertical driving pulse must begin at the same time as the vertical blanking pulse, and so the vertical drive pulse generator must be triggered with the $0 + 2$ pulse. This pulse is selected by the $0 + 2$ gate pulse from the 31.5-kc/sec pulse train in a $0 + 2$ pulse selector in the same way as the $0 + 2$ pulse was selected for the vertical blanking pulse generator. The vertical drive pulse is generated in a blocking oscillator, and the output is squared and clipped previous to the output stage. This output is represented by waveform 25 on Fig. 2.

The four standard outputs represented by waveforms 22, 23, 24 and 25 have been generated from the 31.5-kc/sec pulse train without the use of delay lines, except for front-porch delay and allowance for cable delay, and the timing relations within the standard waveforms have a precise relation to the 31.5-kc/sec trigger pulse train from which the waveforms were derived.

The sources from which the 31.5-kc/sec pulse train can originate will be described.

II. 31.5-KC/SEC TRIGGER SOURCE

The 31.5-kc/sec trigger pulses are supplied from either a crystal-controlled oscillator, or an oscillator, the frequency of which is controllable over a small range on either side of a 31.5-kc/sec center frequency.

The crystal-controlled oscillator consists of a two-stage amplifier with a series resonant 31.5-kc-/sec crystal in the feedback loop. The output of the

oscillator is squared and differentiated, and the desired polarity of trigger pulse is selected by a clipping diode. The crystal oscillator is intended for use when setting up adjustments on the generator and may be used when the power-line frequency is not sufficiently reliable or accurate to allow phase synchronization of the generator to the line.

The controlled oscillator may be used in any of four ways:

(a) the output of the 60-cps countdown phase synchronized to the power supply frequency, i.e., line sychronization;

(b) phase synchronized to an external composite synchronizing signal;

(c) phase synchronized to the 31.5-kc/sec NTSC color subcarrier standard;

(d) free run, primarily for maintenance or test purposes.

A. Line Synchronization

Phase synchronization of the field rate to the power supply frequency is achieved as indicated in Fig. 3. The phase detector differs from conventional detectors of this type in that a bistable multivibrator is used. Trigger pulses derived from the 60-cps line voltage are applied to one input of the flip-flop, and a nominal 60-cps pulse derived from the countdown chain the generator is applied to the other input of the flip-flop. The resulting output of this multivibrator is a square wave, the duty cycle of which is variable according to the phase relation of the two pulse trains entering this detector. The average value of the square wave is detected in a low-pass filter which has a corner frequency of approximately 2 cps, and resulting d-c voltage is used to control the frequency of oscillation of an astable multivibrator.

Figure 4 is partial schematic of the phase detector, filter and controlled oscillator circuitry. The base and collector resistors in the oscillator are low in value to achieve frequency stability and reduce the effects of variations in transistor parameters. To achieve a linear, predictable gain characteristic in the oscillator, the impedance of the control-voltage source should be low, and to satisfy this requirement a complementary common collector stage has been used for the output of the low pass filter. The complementary common collector stage with low output impedance and relatively high input impedance also allows a more predictable filter design.[3]

B. Phase Synchronization to a Composite Sync Signal

Phase synchronization of the generator output to an external composite sync signal is achieved as indicated in Fig. 5. Horizontal phase lock is performed in a manner similar to that of the 60-cps phase lock except that the phase detector is operating at 15.75 kc/-sec and the filter following the phase detector has a corner frequency of a few hundred cycles per second.

The external sync signal is differentiated, and the pulses generated by the leading edge of the horizontal sync components are used to trigger one side of the phase detector.

From the output of the phase detector, an inhibit pulse is derived which is used to remove the alternate pulses into the phase detector caused by the 31.5-kc/sec pulse rate during the vertical interval. The other input to the phase detector is a 15.75-kc/sec pulse train which is derived by selecting alternate pulses from the 31.5-kc/sec source. Horizontal pull-in is rapid and the short-term phase variation between the external sync and generated sync is about 40 millimicroseconds (mμ sec).

Synchronization of the vertical periods is detected in a flip-flop phase detector triggered by the integrated vertical intervals in the external and generated composite sync. However, if the fields are out of synchronism, the phase detector output will allow the generation of inhibiting pulses which are applied to the inputs of the countdown monostables. The inhibiting pulses are generated at a 300-cps rate from the coincidence of the $\div$ 3, $\div$ 5 and $\div$ 7 monostable outputs. The trailing edge of the 3 $\times$ 5 $\times$ 7 coincidence pulse generates an inhibit pulse which is about 75 μsec wide, covering two 31.5-kc/sec trigger pulses. The inhibit pulse is applied to the input of the countdown monostables immediately after each counter has completed a cycle of its operation and inhibits the first two pulses into the counters. Since the start of the next cycle of operation of the counters is delayed, the generation of the vertical interval is delayed, and the vertical period of the composite waveform is brought toward the vertical interval of the external sync signal. When the fields are in synchronism, the bistable action of the phase detector ceases and no further inhibit pulses are generated. Phase synchronization of the vertical periods is held within 1 to 2 lines and the maximum pull-in time is about 2.5 sec.

Phase synchronization to a 31.5-kc/sec NTSC color subcarrier standard is performed in the same way as the horizontal phase lock. The 31.5-kc/sec sine wave is squared and differentiated to produce a trigger pulse train which is the input to the phase detector. Alternate pulses of this input are removed by the inhibiting circuit used to remove the effect of alternate equalizing and vertical sync pulses during external sync signal lock, and the phase detector operates at 15.75 kc/sec as before.

III. CIRCUITRY

A. Pulse Generators

The same basic pulse generator has been used for the horizontal sync pulse, horizontal blank pulse, equalizing pulse, vertical drive and horizontal drive generators, i.e., a blocking oscillator.[4] A representative circuit is that of the horizontal blanking pulse generator, Fig. 6.

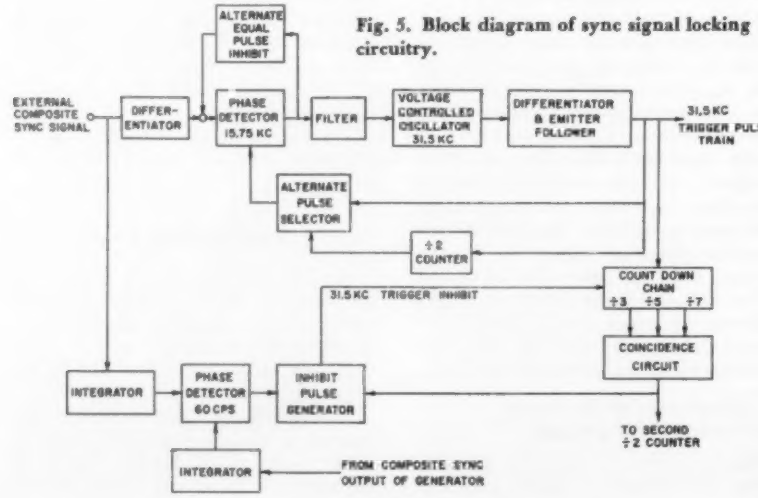


Fig. 5. Block diagram of sync signal locking circuitry.

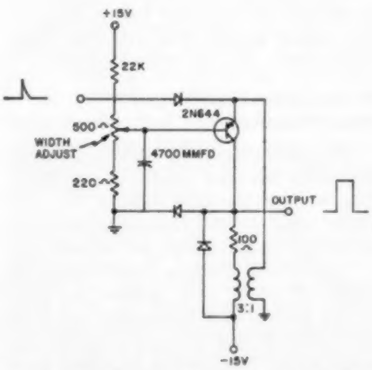


Fig. 6. Blocking oscillator schematic, the horizontal blank pulse generator.

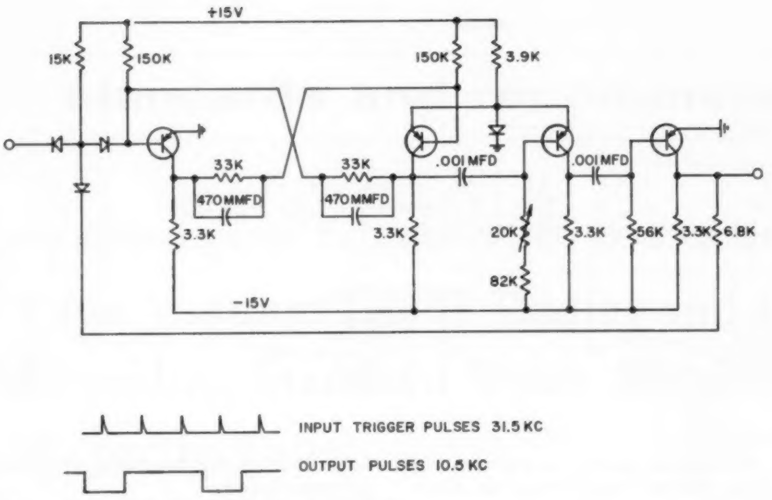


Fig. 7. Schematic of the divide-by-3 counter.

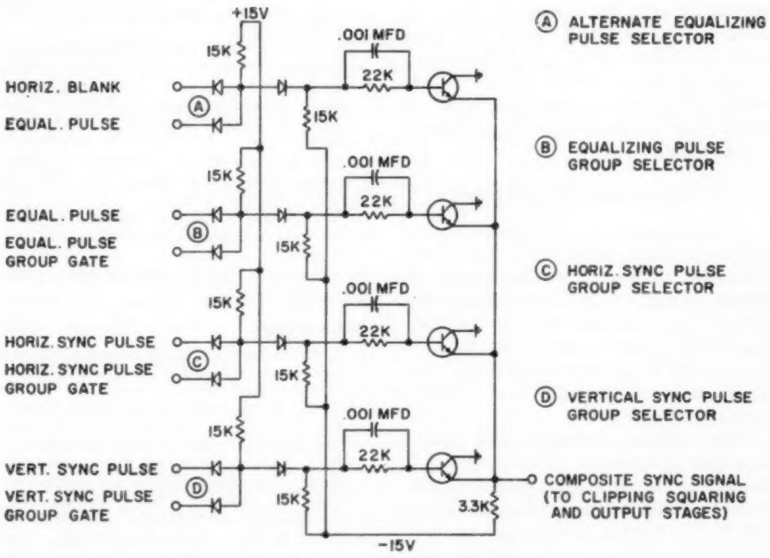


Fig. 8. Schematic of pulse selectors and composite sync mixer.

The pulse duration is determined largely by the design of the pulse transformer, and the width adjustment in the base allows about $\pm 20\%$ variation. The rise and fall times in a circuit of this type are short, 100 mμsec or less, depending upon the transistor characteristics, and the small number of components required gives an economical design.

The vertical sync pulse generator requires a monostable oscillator which has a short recovery time, relative to its "on" time, and since a blocking oscillator of the type described will not allow this short recovery time, the vertical sync pulses have been generated in a monostable multivibrator.[5]

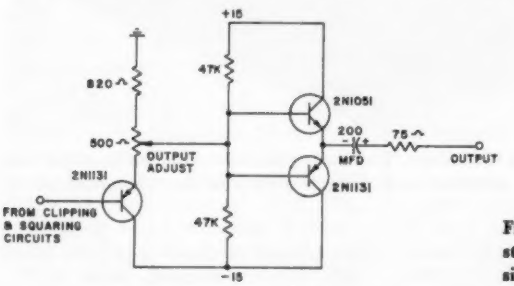


Fig. 9. Schematic of output stage for composite sync signal.

The vertical blanking generator and the selecting waveforms used for the equalizing pulse group gate, vertical sync pulse group gate, etc., are generated by conventional bistable multivibrators as was previously mentioned.

B. Frequency Dividers

The frequency dividing circuits used in the generator are an unconventional bistable-monostable hybrid having a monostable action.[6] A representative circuit is that of the $\div$ 3 counter shown in Fig. 7. When in its quiescent state, the stages are respectively conducting, cut off, conducting and conducting. When the trigger pulse enters, the first stage is cut off, the second is turned on and the third is cut off by the rising edge of the second-stage collector waveform. As the coupling capacitor between the second and third stages discharges through the base biasing resistor of the third stage, the third state is turned on at a time determined by this RC product, and the rising edge of the collector waveform turns off the fourth stage. As the third stage starts to conduct again, the second stage is turned off and the first stage turns on. The value of the RC constant of the fourth stage is such that it generates a pulse at the collector which is approximately 30 μsec wide, and the RC constant of the third stage is adjusted so that the output pulse is centered about the third pulse that enters the monostable after the end of a cycle of its operation. The first stage would trigger on this third entering pulse except that the output is fed back to the input to gate out the third pulse and allow adequate recovery time in the third stage. The process of gating out the trigger pulse before the beginning of the next cycle to allow full recovery produces a more stable dividing circuit in the case of the $\div$ 5 and $\div$ 7 counters. The counter is relatively insensitive to the effects of power supply noise.

C. Mixers

The composite sync mixer and the blanking mixer are similar except that the numbers of inputs is different. The schematic of the sync mixer is shown in Fig. 8. The four grounded collector stages have a common load. The voltage swing out of each of the pulse selectors is roughly the same as the maximum voltage change across the common load resistor, and so the circuit performs both as an adder and a limiter.

D. Output Stages

The output stages for each of the standard sync generator waveforms is the same, except for the coupling capacitor in the output. A schematic of the composite sync output stage is shown in Fig. 9. Following the clipping and

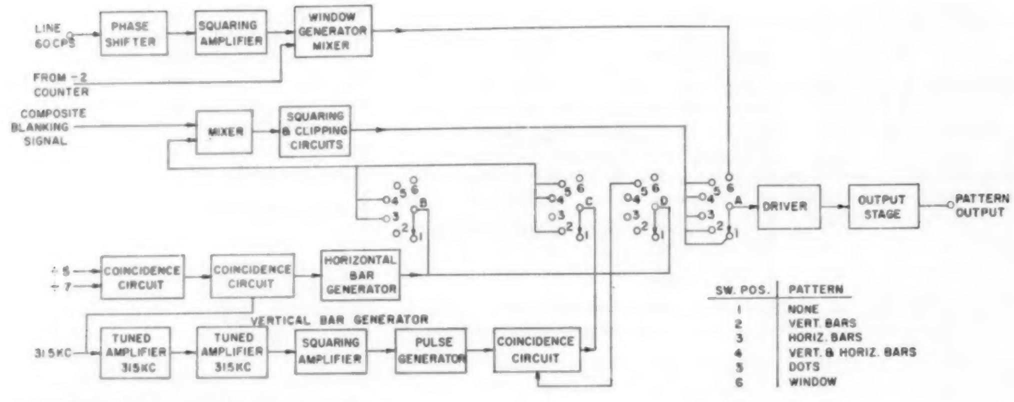


Fig. 10. Block diagram of pattern generator.

squaring circuits, an emitter follower driver stage has been used ahead of the complementary common collector pair which forms the output stage. The output impedance of this pair is very low and a 75-ohm build out resistor has been used for line matching.

IV. ACCESSORY UNIT, PATTERN GENERATOR

In addition to the standard sync generator outputs, the generator may have a bar, dot or window pattern added to a standard blank waveform. The methods used to produce these patterns is illustrated in the block diagram of Fig. 10.

Vertical bars are generated by using a 31.5-kc/sec pulse train to excite a 315-kc/sec resonant circuit in the collector of a common emitter stage. This is followed by a second similarly tuned stage, and the output is squared and differentiated to produce relatively short pulses 0.4 μsec wide. For a vertical bar pattern, these pulses are mixed with the composite blanking signal and go to an output stage.

Horizontal bars are generated at a 900-cps rate by the coincidence of the $\div$ 5 and $\div$ 7 countdown monostable outputs. The coincidence of these pulse trains is used to select every 35th pulse from the 31.5-kc/sec trigger pulses, and these selected pulses trigger a blocking oscillator which has an output pulse approximately 220 μsec (seven lines) in duration. For a horizontal bar pattern, this pulse train is mixed with the composite blanking waveform and applied to an output stage.

A combination of horizontal and vertical bars may be produced by the two above-mentioned pulse trains by mixing both signals with the composite blank waveform. A dot pattern may be produced by using the horizontal-bar signal to gate the vertical-bar signal, as shown for switch position 5 on Fig. 10.

A window pattern is generated by phase shifting a signal from the 60-cps line, squaring this sinusoid in a biased amplifier so that the square-wave output is not symmetrical, and then mixing this signal with the output of the $\div$ 2 counter. The resulting signal will produce a window which has a horizontal dimension equal to about half the screen width and a vertical dimension which is determined by the biasing on the squaring amplifier.

V. MECHANICAL ASSEMBLY

A photograph of the synchronizing signal generator, constructed as has been described in the preceding pages, is shown as Fig. 11. All the circuitry described has been mounted on 14 fiber boards using printed wiring. Each board is mounted in an aluminum frame and all frames are mounted side by side in an aluminum rack.

The complete generator will mount in a rack 19 in. wide, 14 in. deep and 7 in. high. The power supplies and adjustable delay line are mounted behind the circuit boards, and output connectors are located at the rear of the cabinet. Total power consumption of the generator is 27 w.

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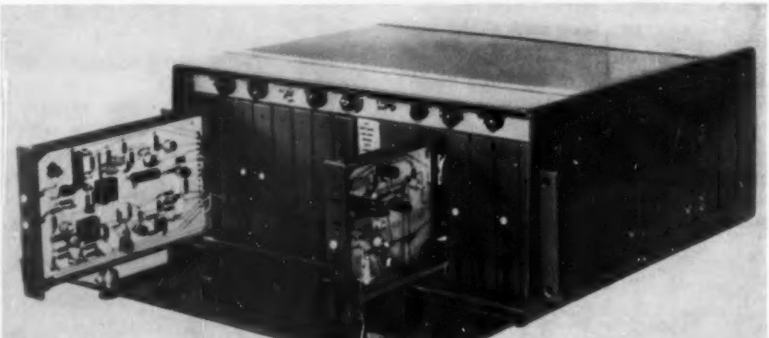


Fig. 11. R20861A Sync Signal Generator. The basic generator plus the line-lock and pulse-lock circuitry, crystal oscillator and pattern generator are contained on 14 printed boards.

standards and recommended practices

PROPOSED SMPTE RECOMMENDED PRACTICE RP 11

Tape Vacuum Guide Radius and Position for Recording Standard Video Records on 2-In. Magnetic Tape

Published here for a three-month period of trial and comment is Proposed SMPTE Recommended Practice RP 11, Tape Vacuum Guide Radius and Position for Recording Standard Video Records on 2-in. Magnetic Tape.

The proposal, initiated by the Society's Video Tape Recording Committee, was approved by that committee and the Standards Committee. Comments should be sent to Alex E. Alden, Staff Engineer, prior to January 15, 1962. If no adverse comments are received, the proposal will be submitted to the Board of Governors for approval.—AEA

1. *Scope*

This recommended practice specifies the tape vacuum guide radius and position for recording standard video records on 2-in. magnetic tape.

2. *Mechanical Dimensions*

2.1 The radius of the tape vacuum guide shall be 1.0334, +0.0000, −0.0005 in. (26.248, +0.000, −0.013mm).

2.2 The position of the vacuum guide shall be set so that the eccentricity of its center of curvature with respect to the axis of rotation of the video heads is as indicated in the table. The eccentricity shall be such that the extension of a line joining the center of curvature of the vacuum guide and the axis of rotation of the heads intersects the tape at the midpoint of its width. The center of curvature of the vacuum guide shall lie between the axis of rotation of the heads and the vacuum guide.

Vacuum Guide Radius		Eccentricity	
Inches	Millimeters	Inches	Millimeters
1.0334	26.248	0.0000	0.000
1.0333	26.246	0.0001	0.003
1.0332	26.243	0.0002	0.005
1.0331	26.241	0.0003	0.008
1.0330	26.238	0.0004	0.010
1.0329	26.236	0.0005	0.013

Note: These dimensions are based on a nominal tape thickness of 0.0014 inch (0.0356mm) and a radius of rotation of the magnetic head pole tips of 1.0329 inch min. to 1.0356 inch max.

APPENDIX

The achievement of tape playback interchangeability requires, among other things, that means be provided to accommodate variations of (a) the radius of rotation of the magnetic head pole tips, (b) the radius of the vacuum guide and (c) tape thickness. These effects are compensated by the stretching of the tape into a slot cavity in the vacuum guide by virtue of the radius of rotation of the magnetic head pole tips projecting beyond the unstretched oxide surface of the tape as held in the vacuum guide. Over the limits normally encountered, the stretching provides automatic compensation if the vacuum guide is positioned to give the minimum geometric distortion in the reproduced picture.

Proposed American Standards

The proposals published here have been approved by the engineering and Standards Committees and are submitted for a three-month period of trial and comment:

PH22.128, 8mm Flutter Test Film, Magnetic Type, Perforated IR-1500
PH22.129, 8mm Azimuth Test Film, Magnetic Type, Perforated IR-1500
PH22.130, 8mm 400-Cycle Signal Level Test Film, Magnetic Type, Perforated IR-1500
PH22.131, 8mm Multifrequency Test Film, Magnetic Type, Perforated IR-1500

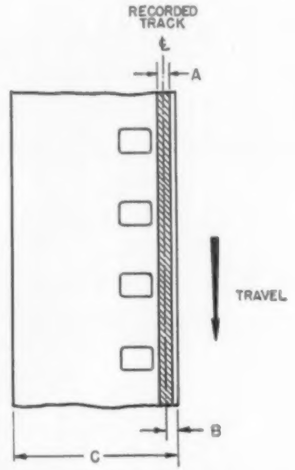
Keeping abreast of the rapid growth of 8mm sound, the Sound Committee, under the chairmanship of James L. Pettus and the cooperation of Ellis W. D'Arcy, has developed a series of 8mm sound standards. Four of these standards are published here describing the test films the Society is adding to its present test film program. These four test films are, in effect, duplicates of the 16mm test films that have proven to be of great value over the past years.

All comments should be addressed to Alex E. Alden, Staff Engineer, at Society Headquarters prior to January 15, 1962. If no adverse comments are received by that date, the proposals will be submitted to ASA Sectional Committee PH22 for further processing.—*AEA*

Proposed American Standard

8mm Flutter Test Film, Magnetic Type, Perforated 1R-1500

PH22.128



1. Scope

This standard specifies a 3000 cps magnetic sound test film for use in determining the presence of flutter in 8mm magnetic sound reproducers.

2. Test Film

2.1 The test film shall have an originally recorded 0.025-in. minimum width magnetic sound record, the location and dimensions of which shall be as specified in the diagram and table.

2.2 With the direction of film travel as shown in the diagram, the magnetic coating shall be on the upper face of the film.

2.3 The recorded frequency shall be 3000 ± 25 cps with a film rate of 24 perforations per second (approximately 18 ft per minute).

2.4 The recorded level shall have an average intensity of 10 gauss with a tolerance of +0 −3 db.

2.5 The total rms flutter of the sound record shall not exceed 0.10 percent and the flutter amplitude, at any single flutter rate, shall not exceed 0.05 percent (as defined in American Standard Method for Determining Flutter Content of Sound Recorders and Reproducers, Z57.1-1954). (See Section 6.)

3. Film Stock

The film stock shall be of the low-shrinkage safety type, cut and perforated in accordance with American Standard Dimensions for 8mm Motion-Picture Film, PH22.17-1954. (See Section 6.)

4. Length of Film

The film shall be supplied in 100-ft lengths, stocked and furnished on spools with 2-in. hubs.

5. Identification

The film shall have identification markings at both ends.

Dimensions	Inches	Millimeters
A	0.025 min	0.64 min
B	0.015 ± 0.001	0.38 ± 0.03
C	0.314 nom	7.98 nom

6. Revision of American Standards Referred to in This Document

When the following American Standards referred to in this document are superseded by a revision approved by the American Standards Association, Incorporated, the revision shall apply:

American Standard Dimensions for 8mm Motion-Picture Film, PH22.17-1954;

American Standard Method for Determining Flutter Content of Sound Recorders and Reproducers, Z57.1-1954.

APPENDIX

(This Appendix is not a part of Proposed American Standard 8mm Flutter Test Film, Magnetic Type, Perforated IR-1500, PH22.128, but is included to facilitate its use.)

It is recognized that there are certain desirable features in a test film of this kind that will simplify its use in measuring flutter. Because of the variety of flutter-measuring meters, one such feature is reasonable uniformity of the level of reproduction throughout the length of the test film. Therefore, it is recommended that the variations in the output level throughout the length of the test film, as measured by a VU-type meter, shall be less than ± 1 db. Short-term level variations, as for example those resulting from drop-outs, may cause some difficulty in the use of this film. Since these do not lend themselves to precise manufacturing specifications, maximum care should be exercised in the preparation of this film to minimize these variations.

Proposed American Standard

8mm Azimuth Test Film, Magnetic Type, Perforated 1R-1500

PH22.129

1. Scope

This standard specifies a test film having a magnetic sound record to be used for aligning the azimuth of magnetic heads on 8mm magnetic recording and reproducing equipment.

2. Test Film

2.1 The test film shall have an originally recorded 0.025-in. minimum-width magnetic sound record, the location and dimensions of which shall be as specified in the diagram and table.

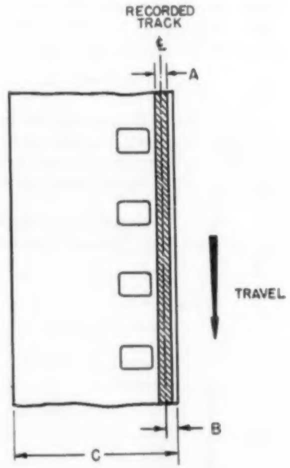
2.2 With the direction of film travel as shown in the diagram, the magnetic coating shall be on the upper face of the film.

2.3 The frequency of the sound record shall be approximately 7000 cps when the film travel rate is 24 perforations per second (approximately 18 ft per minute).

2.4 The sound record shall be recorded at 90° with reference to the edge of the film within $\pm$ 3 minutes of arc.

2.5 The recorded level shall have an average intensity of 10 gauss with a tolerance of $+0$ -3 db.

2.6 The recorded signal steadiness, when reproduced on high quality equipment and measured with a VU meter, shall be held to a tolerance of $\pm$ 0.5 db through any 100-ft length of film. Exception may be made for occasional rapid level fluctuations such as may be caused by "drop-outs."



3. Film Stock

The film stock used shall be of the low-shrinkage safety type, cut and perforated in accordance with American Standard Dimensions for 8mm Motion-Picture Film, PH-22.17-1954. (See Section 6.)

Dimensions	Inches	Millimeters
A	0.025 min	0.64 min
B	0.015 $\pm$ 0.001	0.38 $\pm$ 0.03
C	0.314 nom	7.98 nom

NOT APPROVED

4. Length of Film

The film shall be supplied in 100-ft lengths, stocked and furnished on spools with 2-in. hubs.

5. Identification

The film shall have identification markings at both ends.

6. Revision of American Standard Referred to in This Document

When the following American Standard referred to in this document is superseded by a revision approved by the American Standards Association, Incorporated, the revision shall apply:

American Standard Dimensions for 8mm Motion-Picture Film, PH22.17-1954.

PH22.129 NOT APPROVED

Proposed American Standard

8mm 400-Cycle Signal Level Test Film, Magnetic Type, Perforated 1R-1500

PH22.130

1. Scope

This standard specifies a 400-cycle signal level magnetic test film for use in controlling magnetic sound recording levels and standardizing methods of signal-to-noise measurements on 8mm magnetic sound systems.

2. Test Film

2.1 Dimensions of Sound Record. The test film shall have an originally recorded 0.025-in. minimum-width magnetic sound record, the location and dimensions of which shall be as specified in the diagram and table.

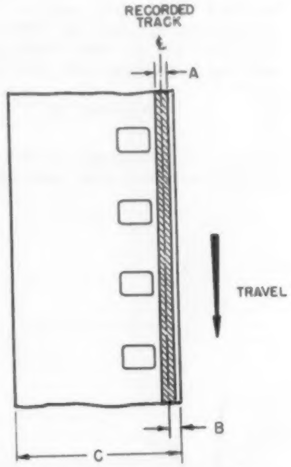
2.2 Magnetic Coating. With the direction of film travel as shown in the diagram, the magnetic coating shall be on the upper face of the film.

2.3 Test Frequency. The recorded frequency shall be 400 ± 4 cycles per second.

2.4 Mean Film Speed. In recording and reproducing, the film shall pass through the equipment at a rate of 24 perforations per second (approximately 18 ft per minute) with a mean film speed tolerance of ±0.5 percent.

2.5 Distortion. The total harmonic distortion of the recorded signal frequency shall not exceed 3.0 percent.

2.6 Signal Level Fluctuation. The level fluctuation of the test film shall be within ±1 db.



2.7 Permissible Flutter. The total flutter shall be within ±0.1 percent.

2.8 Recorded Signal Level. The magnetic record shall have a recorded intensity of 10 ± 0.5 gauss which is to be determined by the method of calibration specified in 6.1.

3. Film Stock

The film stock used for the test film shall be cut and perforated in accordance with American Standard Dimensions for 8mm Motion-Picture Film, PH22.17-1954. (See Section 7).

Dimensions	Inches	Millimeters
A	0.025 min	0.64 min
B	0.015 ± 0.001	0.38 ± 0.03
C	0.314 nom	7.98 nom

4. Length of Film

The film shall be supplied in 100-ft lengths, stocked and furnished on spools with 2-in. hubs.

5. Identification

Each test film shall be provided with a suitable leader, title and trailer, and shall be accompanied by a calibration of the level of the frequency recordings.

6. Calibration

6.1 The film shall be calibrated in accordance with the inductive loop method as described in the following reference:

Robert Schwartz, "Absolute measurement of signal strength on magnetic recordings: phase II," *Jour. SMPTE, 66*: 119–122, Mar. 1957.

6.2 Calibration Tolerance. The calibration shall be within ±½ db of the true signal level.

7. Revision of American Standard Referred to in This Document

When the following American Standard referred to in this document is superseded by a revision approved by the American Standards Association, Incorporated, the revision shall apply:

American Standard Dimensions for 8mm Motion-Picture Film, PH22.17-1954.

Proposed American Standard

8mm Multifrequency Test Film, Magnetic Type, Perforated 1R-1500

PH22.131

1. Scope

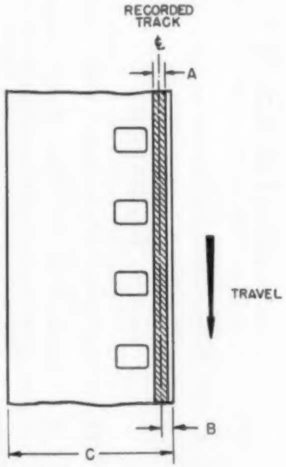
This standard specifies a multifrequency magnetic sound test film for use in standardizing the replay chain for 8mm magnetic sound film.

2. Test Film

2.1 Dimensions of Sound Record. The test film shall have an originally recorded 0.025-in. minimum-width magnetic sound record, the location and dimensions of which shall be as specified in the diagram and table.

2.2 Magnetic Coating. With the direction of film travel as shown in the diagram, the magnetic coating shall be on the upper face of the film.

2.3 Film Content. The film shall contain the following recorded frequencies:



Frequency, cycles	Tone Footage, feet	Signal Levels* db ref. 10 gauss	Signal Levels* absolute level gauss	Frequency, cycles	Tone Footage, feet	Signal Levels db ref. 10 gauss	Signal Levels absolute level gauss
7000**	15	+ 2.2		2000	3	0.15	
400	6	—10	3.16	3000	3	1.3	
50	3	—27.7		4000	3	1.7	
100	3	—21.7		5000	3	1.95	
200	3	—15.75		6000	3	2.1	
300	3	—12.3		7000	3	2.2	
500	3	— 8.1		400	6	—10	3.16
1000	3	— 3.15					

Dimensions	Inches	Millimeters
A	0.025 min	0.64 min
B	0.015 ± 0.001	0.38 ± 0.03
C	0.314 nom	7.98 nom

*The signal level tolerance shall be within ± 1.5 db.
**For azimuth adjustment.

2.4 Mean Film Speed. In recording and reproducing, the film shall pass through the equipment at a rate of 24 perforations per second (approximately 18 ft per minute) with a mean film speed tolerance of ±0.5 percent.

2.5 Frequency Tolerance. The recorded frequency signal shall not vary in excess of ±2 percent of the nominal frequency of each portion of the test track.

2.6 Reference Signal Level. The 400-cycle signal shall be −10 db absolute level (3.16 gauss) with reference to Proposed American Standard 8mm 400-Cycle Signal Level Test Film, Magnetic Type, Perforated IR-1500, PH22.130.

2.7 Permissible Flutter. The total RMS flutter shall be within ±0.1 percent as measured in accordance with American Standard Method for Determining Flutter Content of Sound Recorders and Reproducers, Z57.1-1954. (See Section 7.)

2.8 Distortion. The total harmonic distortion at any of the recorded frequencies below 3000 cycles shall not exceed 3.0 percent.

3. Film Stock

The film stock used for the test film shall be cut and perforated in accordance with American Standard Dimensions for 8mm Motion-Picture Film, PH22.17-1954. (See Section 7.)

4. Length of Film

The film shall be supplied in 100-ft lengths, stocked and furnished on spools with 2-in. hubs.

5. Identification

Each test film shall be provided with a suitable leader, title, and trailer.

6. Calibration

6.1 The film shall be calibrated in accordance with the short-gap method as described in the following references:

J. D. Bick, "Methods of measuring surface induction of magnetic tape," *J. Audio Eng. Soc., 1*: 4, Jan. 1953. Reprinted, *Jour. SMPTE, 60*: 516-525, Apr. (Pt. II) 1953;

E. D. Daniel and P. E. Axon, "The reproduction of signals recorded on magnetic tape," *Proc. IEE, Part III*: 157, May 1953;

Robert Schwartz, Sheldon I. Wilpon and Frank A. Comerci, "Absolute measurement of signal strength on magnetic recordings," *Jour. SMPTE, 64*: 1–5, Jan. 1955.

6.2 Film Calibration. Each test film frequency shall be measured with a calibrated head as described in 6.1. The readings so determined shall be supplied with the test film.

6.3 Calibration Tolerance. The Calibration shall be within ±½ db of the true signal level.

7. Revision of American Standards Referred to in This Document

When the following American Standards referred to in this document are superseded by a revision approved by the American Standards Association, Incorporated, the revision shall apply:

American Standard Dimensions for 8mm Motion-Picture Film, PH22.17-1954;

American Standard Method for Determining Flutter Content of Sound Recorders and Reproducers, Z57.1-1954.

91st Convention and Equipment Exhibit

April 29–May 4, 1962—Ambassador Hotel, Los Angeles

It is always gratifying to find another Hollywood Convention looming up on the horizon. Two years ago, almost to the day, more than 2000 people thronged the Ambassador to make the 87th Convention a high point in the Society's history. In the expectation that the 91st will be even bigger in every way, preliminary organization work was started unusually early.

The theme of the Convention this time is to be: **Advances in Color Motion Pictures and Color Television.** Solicitation of papers has started, according to the Program Chairman, **Edward P. Ancona, Jr.,** 3170 Lake Hollywood Drive, Hollywood 28. Those intending to contribute should note that the deadline for abstracts to be submitted to the Program Chairman and Topic Chairman is February 12, 1962.

In recognition of the expanding international character of the Society and increasing participation by visitors from overseas in recent conventions the Program Chairman is to be assisted this time by an Associate Chairman for International Papers: **D. J. White,** Magnasync Corp., 5546 Satsuma Ave., North Hollywood, who will coordinate papers from abroad.

Topics and Topic Chairmen for the technical program of the 91st Convention are as follows:

Cinematography: William Widmayer, Columbia Pictures Corp., 1438 Gower, Hollywood 28.

Closed-Circuit TV Systems: D. C. Yarnes, RCA Film Recording & TV Systems, 1560 N. Vine St., Hollywood 28.

Instrumentation and High-Speed Photography: Carlos H. Elmer, Traid Corp., 17136 Ventura Blvd., Encino, Calif.

Industrial and Educational Films: John C. Mahon, Jr., 15335 Del Gado Dr., Sherman Oaks, Calif.

Laboratory Practices: Fred J. Scobey, General Film Laboratories, Inc., 1546 N. Argyle Ave., Hollywood 28.

Optics and Optical Systems: Alan M. Gundelfinger, Technicolor Corp., 6311 Romaine St., Hollywood 38.

Photographic Materials and Equipment: John M. Waner, Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38.

Projection Practices: Walter Beyer, 1110 N. Ardmore Ave., Hollywood 28.

Set Construction and Special Effects: Herbert Meyer, 325 Sequoia Dr., Pasadena 2, Calif.

Short Film Subjects: Ted Fogelman, Consolidated Fiim Industries, 959 N. Seward St., Hollywood 38.

Sound Recording and Reproduction: Fred G. Albin, Ryder Sound Services, Inc., 1161 N. Vine St., Hollywood 28.

TV Equipment and Techniques: Edward E. Benham, Crowell-Collier Broadcasting Corp., 6419 Hollywood Blvd., Hollywood 28.

Television Recording: Eliot Bliss, CBS Television, 7800 Beverly Blvd., Los Angeles 36.

For the convenience of contributors in all parts of the world in need of advice or assistance in the preparation and submission of papers there follows the list of Regional and National Regional Chairmen of the Papers Committee. These gentlemen have Author Forms available. The National Regional Chairmen will assist the Associate Chairman for International Papers, D. J. White, in providing papers from other countries.

General Chairman, *Robert C. Rheineck*, CBS News, 485 Madison Ave., New York 22.

Regional Chairmen (United States)

Charles D. Beeland, Chairman, Atlanta, Charles D. Beeland Co., 70 Fourth St., N.W., Atlanta 8, Ga.

Harold E. Edgerton, Chairman, Boston, MIT, Dept. of Electrical Engineering, 77 Massachusetts Ave., Cambridge 39, Mass.

Jack Behrend, Chairman, Chicago, Behrend Cine Corp., 161 East Grand Ave., Chicago 11, Ill.

Roddy K. Keitz, Chairman, Dallas-Ft. Worth, Keitz & Herndon, Inc., 3601 Oak Grove, Dallas 4, Texas

Ralph L. Hucaby, Chairman, Nashville, 945 Caldwell Lane, Nashville, Tenn.

J. Paul Weiss, Chairman, New York, E. I. du Pont de Nemours & Co., Photo Products Dept., Parlin, N.J.

C. Loren Graham, Chairman, Rochester, Eastman Kodak Co., Bldg. 65, Kodak Park, Rochester 15, N.Y.

R. A. Isberg, Chairman, San Francisco, 2519 Parker St., Berkeley 4, Calif.

Max Beard, Chairman, Washington, 10703 East Nolcrest Dr., Silver Spring, Md.

National Regional Chairmen

Western Hemisphere (except United States)

Argentina: *Pablo Tabernero*, Laboratorios Alex S. A., Dragones 2250, Buenos Aires

Brazil: *Joseph Illes*, Laboratorios Policrom, Rua 13 de Maio, 402, Sao Paulo

Canada: *Rodger J. Ross*, Canadian Broadcasting Corp., 354 Jarvis St., Toronto, Ont.

Chile: *Andres Martorell De Llanza*, Casilla 3043, Santiago

Colombia: *Pablo E. Carrasco*, Kodak Colombiana Ltd., Carrera 13, No. 18-66, Bogota

Mexico: *Paul M. Wilson*, Kodak Mexicana Ltd., Londres 16, Administracion De Correos 68, Mexico 6, D.F.

Puerto Rico: *Pedro Mabanta*, Kodak Puerto Rico Ltd., 305 Ponce de Leon, P.O. Box 5006, Puerta de Tierra, San Juan 4

Venezuela: *Alfredo J. Rosaiano*, Bolivar Films, C.A., Apartado 786, Caracas

Peru: *Jose Maria Rosello*, Estudios Cinematograficos Rosello, Casillo Correo 3116, Lima

Europe

Denmark: *Michael M. Jacobsen*, Filmtech Copenhagen, Jenslovs Tvaervej 1A, Charlottenlund

France: *Fred Orain*, 128, Rue La Boetie, Paris 8e

Germany: *Adolf Kochs*, Wilhelm-Keim-Strasse 23, Munich

Great Britain: *Leslie Knopp*, The Cinematograph Exhibitors' Assn. of Great Britain & Ireland, 164 Shaftesbury Ave., London W.C.2

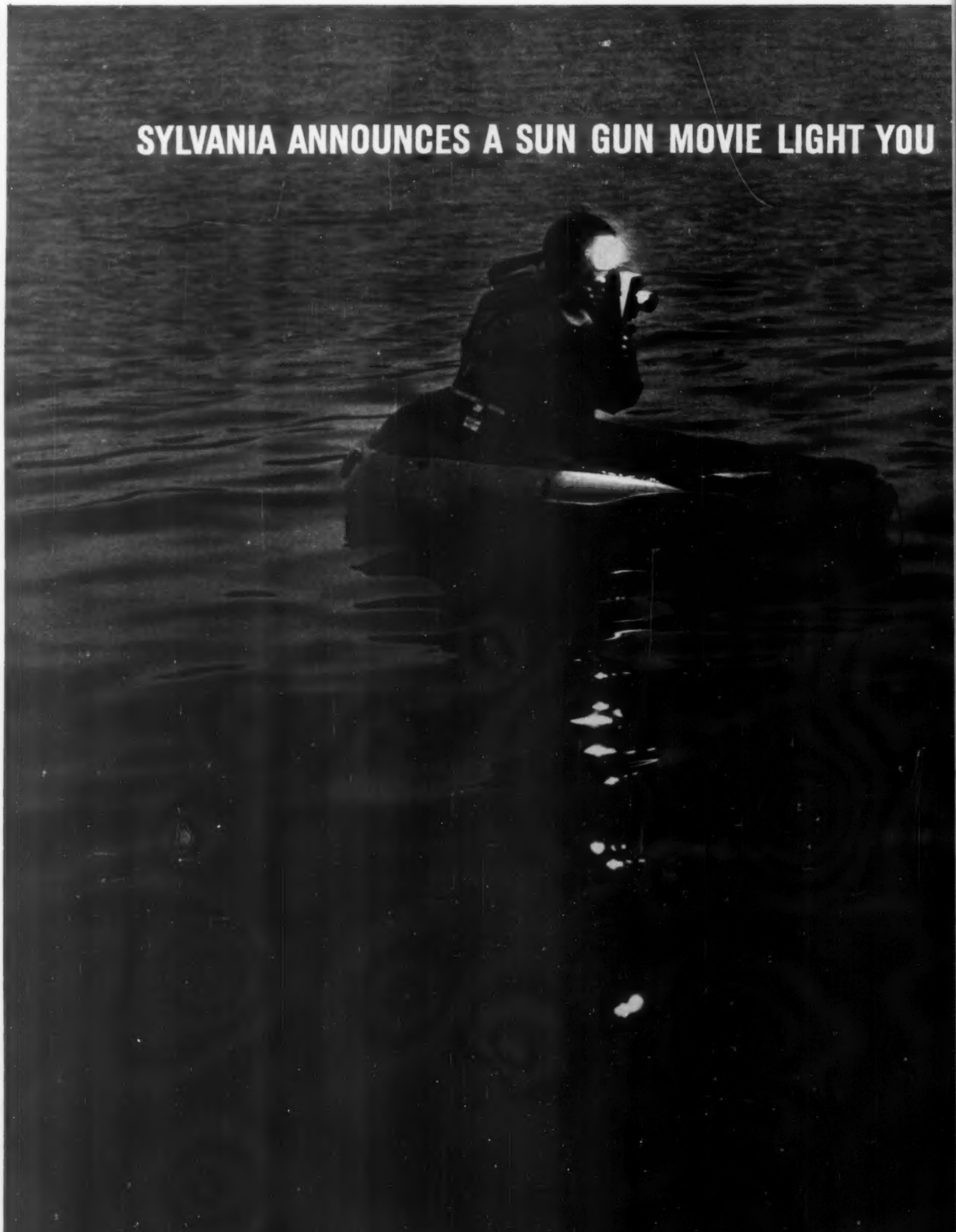
Italy: *Mario Calzini*, Tecnostampa Labs, 38 Via Albalonga, Rome

The Netherlands: *E. J. Verschueren*, Wagnerlann 9, Hilversum

Sweden: *Osten Soderlund*, Hasselblads, Fotografiska AB, Motion Picture Dept., P.O. Box 428, Goteborg 1

Switzerland: *Robert Suter*, Turicop SA, Regensbergstrasse 243, Zürich 11/50

U.S.S.R.: *Victor G. Komar*, Cinema Photo Research Institute (NIKFI), Leningradsky Prospect 47, Moscow


SYLVANIA ANNOUNCES A SUN GUN MOVIE LIGHT YOU

Africa

SOUTHERN RHODESIA: *Geoffrey Mangin*, Associated Rhodesian Telefilms, 47 North Ave., P.O. Box 8252, Salisbury

Asia

INDIA: *H. Krishnan*, Kodak Ltd., P.O. Box No. 343, Kodak House, Dr. Dadabhai Naoroji Rd., Bombay 1

JAPAN: *Kiyohiko Shimasaki*, Motion Picture Engineering Society of Japan, Inc., Sankei-Kaikan Bldg. No. 3 Otemachi-1, Rm. 271, Chiyoda-ku, Tokyo

PHILIPPINES: *Juan D. Fornoles*, L. V. N. Pictures, Inc., P.O. Box 3610, Manila

Australasia

AUSTRALIA: *P. H. Budden*, Commonwealth Film Labs, 35 Missenden Rd., Camperdown, N.S.W.

NEW ZEALAND: *M. J. Ashley*, National Film Unit, Darlington Rd., Miramar, Wellington E.4

Local Arrangements

The mammoth job of organizing the physical arrangements and supervising the myriad details of a big SMPTE Convention in Hollywood on this occasion will be under the capable direction of **Ralph Lovell,** 2554 Prosser Ave., Los Angeles 64, as Chairman of the Local Arrangements Committee. Assisting him will be:

Vice-Chairman: *Jack Kiel*, Photo-Sonics, Inc.

Hotel Arrangements: *D. J. White*, Magnasync Corp.

Exhibit: *George Kendall*, Moviola Mfg. Co.

Projection: *Merle H. Chamberlin*, M-G-M Studios

Hospitality Co-Hostesses: *Mrs. Ralph E. Lovell, Mrs. Harry Teitelbaum*

Publicity: *Thornton Sargent, Jack Goetz*

Further appointments will be announced later.

Equipment Exhibit

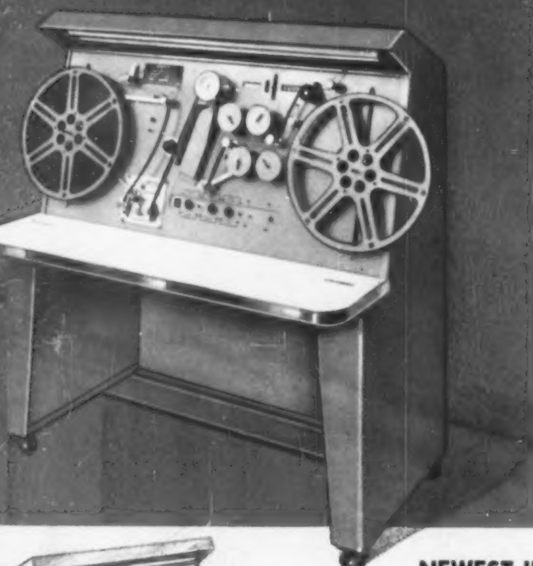
Visitors to the last Hollywood Convention will remember the busy and bustling exhibit of millions of dollars' worth of video and film equipment that filled the Ambassador's Sunset Room and spilled out into the Registration area. So many would-be exhibitors were turned away that time that for the 91st arrangements have been made for double the amount of space for the Exhibit. Both the Sunset and Boulevard Rooms, lying each side of the ballroom where the technical sessions will be held, have been made available, and the resulting show should be something indeed to see. There is little doubt that we can expect last time's attendance of 2000 plus to be easily topped.

Brochures and order forms for reserving space are now being mailed. Anyone who has not received these and who wants to be sure to get them would be well advised to contact the Exhibit Chairman — **George Kendall,** Moviola Mfg., 1451 Gordon St., Hollywood 28 — and indicate his interest.

New Equipment and Techniques

As in the past, there will be an Equipment Papers and Demonstrations Session at this Convention consisting of short, practical papers and talks by exhibitors. Only exhibitors will be invited to participate in this session as speakers; attendance will be open to all holders of Exhibit Passes as well as convention registrants. The equipment described or demonstrated must be new and never before shown at an SMPTE convention.

MODEL "U" MARK II



America's most popular film inspection unit

USED BY LEADING FILM LIBRARIES OF THE WORLD

The Model "U" Mark II is a dynamic machine that has won the praise of leading film library managers everywhere. It is considered the "Work-Horse" of the film inspection field. Designed to be the fastest, easiest to use, easiest to service, most accurate, top performing machine (exceeded only by the Mark IV) but for the vast middle of the road conservative managers market—this unit is the one.

Features eye-level non-stoop open path loading, for operator ease and convenience. Has Harwald originated "Plug-In" interchangeable service parts construction. All console style machines can be used with electronic cleaning and conditioning. Can be duplexed—used as double "L" or double "H". Electronic loading available (see Deluxe Model). Special Features: Triple jewel controlled low pressure detection, ultra smooth drive, no break no snap starting. Top performance—for the pros!

Since this unit is constantly improved as results from the field show new features valuable, so be sure to get the latest information on it before buying. Simply contact our sales dept., and ask for special 81 feature list.

No. 2J102 Ship. Wt., 350 lbs. **$2,795.00**

DELUXE MODEL "U" MARK II

Same as above unit, but with large table, magnifier electronic loading, special wind switch and other deluxe features. Please contact us for features and details. Price **$2,995.00**

MODEL "U" SPECIAL

Here's a superb product for the little library to start on. Designed with ample space for adding most Mark II features. It is real easy to use. Full console size with big work surface. Features easy eye-level loading and has Harwald's patented Triple Jewel Detection System.

No. 2J103 Ship. Wt., 270 lbs. **$2449.00**

PROFESSIONAL OPERATOR CHAIR

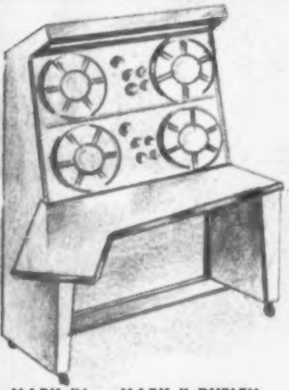
This famous Harwald professional operator chair is designed for maximum comfort. Beautifully styled, strong and it's cool. Has 6 separate adjustments and it is practically indestructable. Ship. Wt., 29 lbs. Sells elsewhere at $39.95.

No. 13J101 only **$34.95**

SAVE $5.00

NEWEST IDEAS FOR MODERN FILM LIBRARY INSTALLATION

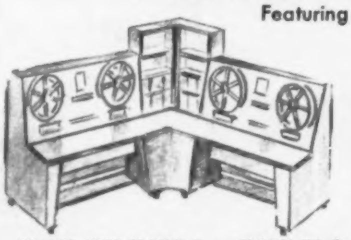
Featuring easy eye-level non-stoop loading and famous triple jewel detection

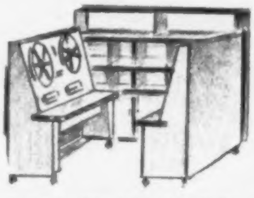


MARK IV or MARK II DUPLEX

Smallest floor area, greatest comfort and output for Duplex setup. Ideal, where space is prime consideration. Permits operator better control over reels with less fatigue than other stacked or Duplex arrangements. Please write for list of features.

Priced **$3,995.00 to $6,995.00** depending on accessories

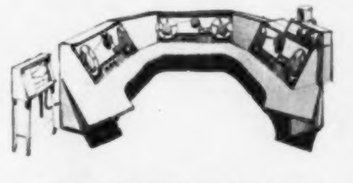




MODEL "U" MARK II or MARK IV Custom "L" or "Double I" Installation

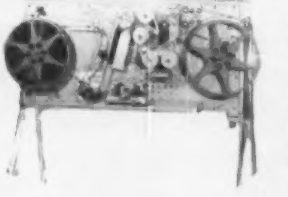
The most popular 2-machine setup. Here is by far the most popular arrangement of film inspection machines, used by perhaps 9 out of 10 leading libraries. It gives maximum output per unit floor space with greatest operator comfort—from easy eye-level loading.

No. 2J110 Ship. Wt., 750 lbs. . . . . **$2,950.00 per unit**



"TRIPLEX" MARK II or MARK IV

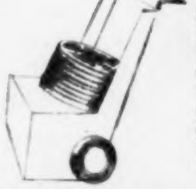
The concept of the future. For those who wish to maximize operator performance, yet have easy eye-level operation. This setup is a custom installation. Please write for list of features.



MODEL "R" INSPECT-O-FILM

The famous "Old Reliable". As rugged as the old "DC-3" air plane. Designed for medium-speed inspection of release prints in 16mm libraries. These machines simply will not die! Ship. Wt., 250 lbs.

No. 2J101 . . . . . **$1,995.00**



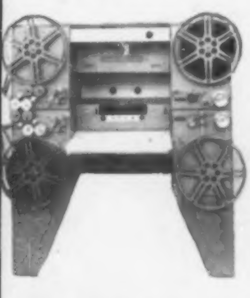
QUALITY PUSH CART

Scientifically designed to solve the problems of holding and moving film easily. Adjustable shelf for right height. Sturdy construction. Holds up to 30-2000 ft. reels. A Quality Product. 40 lbs.

No. 13J106 . . . . . . **$49.00**

CONSOLETTE STYLE FILM INSPECTION

Superior Competitive Units for the Small User



ULTRA MODERN DUPLEX
Junior Challenger

A superior competitive unit for less. Next to stacked Model "U" or Mark IV units, these give maximum output per unit floor space. You must see this unit and compare, prove to yourself how it exceeds competitive units, for less cost.

No. 2J109 600 lbs. **$2995.00**

DUPLEX-DELUXE

Extra features for greater performance. Low stretch—low stoop design. Please write for complete list of superior features. 625 lbs.

No. 2J107 . . . . **$3,895.00 to 5,950.00** depending on accessories

MODEL 76 "CHALLENGER"
Junior Consolette Inspect-O-Film

A superior competitive unit for less. Priced for the little library where consolette design and low loading are acceptable. This machine is in every way superior to competitive makes and we willingly offer it for your close examination and test against any other film inspection machine. Often copied, but never equalled, this all American-Made machine has Harwald's patented detection and outstandingly smooth drive system, safe on film—a real bargain. Please write for feature list.

No. 2J104 325 lbs. **$2,249.00**

JUNIOR DELUXE INSPECT-O-FILM

(Not Illustrated) Similar to Model 76 "Challenger", with extra features of Electronic Loading, Triple Jewel Model "U" type detection system and others. For details, please write for complete list of features.

No. 2J106 350 lbs. **$2,495.00**

REWIND-O-FILM

A dandy consolette style hand inspection and automatic rewind set up. Trade this machine up as your library grows, to automatic inspection for any Harwald model.

No. 2J108 270 lbs. **$799.00**

NEW and USED UNITS—RENTALS —LEASES

Rental to purchase agreements, available on all equipment. Get a FREE industrial engineering analysis. If you have over 200 films, you are probably paying for automatic inspection but not getting it.

PLANNING A MODERN, PROGRESSIVE FILM LIBRARY?

Get Harwald's famous "Past and Future" literature and get help from our qualified sales engineers.

HARWALD'S FAMOUS SERVICE POLICY

Available for all units. We trade, repair, rebuild, redesign and modify all and any type of film handling equipment. Call Mr. Service for details.

We are a service oriented organization. Our sales come largely from recommendations of happy customers. Take advantage of our original "Collect Call Service". An expert is as near as your telephone. Our nationwide organization is always at your service.

ALL PRICES F.O.B. SHIPPING POINT SUBJECT TO CHANGE WITHOUT NOTICE PRINTED IN U.S.A.

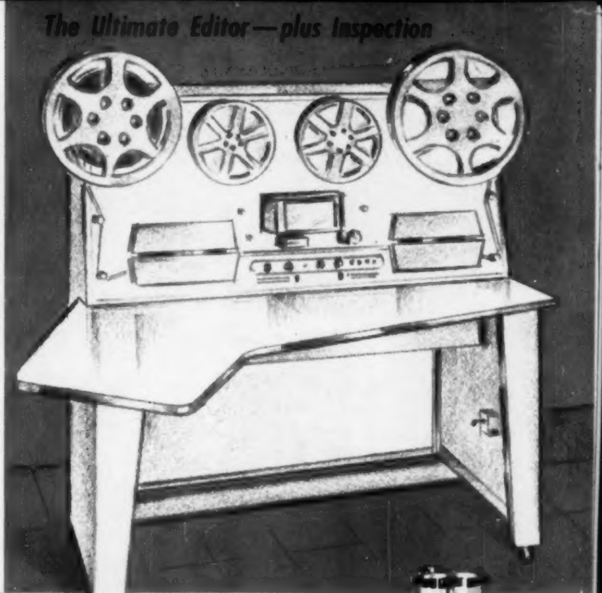
MODEL "Q" MARK IV

A new concept of the famous Model "Q" Editing Machine. Ideal for TV Stations, Producers, Distributors, etc.

Here is the ultimate in film handling for professional film men in TV stations and for film distribution. This machine not only has all the features of the Mark IV, described on the front cover, including the availability of scratch detection, etc., but also has a viewer and sound reader arrangement so that films may be viewed, edited, cut and an entire TV Show put together with the greatest of ease, in a professional manner.

Often times users report cutting down their time as much as in half of that with normal complicated arrangements and this machine does a complete job. Not only inspects film and cleans it, but times the film and allows it to be viewed at an extremely fast pace. For instance an hour program can be completely previewed in less than five minutes. Complete smooth control over the film movement is possible and all the way from zero to 450 feet a minute, forward and reverse. No solenoids, easy service, no belts—a whole new concept in design!

No. 3J102........Price, depending on accessories, **$4,495.00 to 7,995.00**


The Ultimate Editor—plus Inspection

STANDARD MODEL "Q" INSPECT-O-FILM EDITOR

Here is a professional tool offering electronic inspection, cleaning, measuring, viewing and sound reading for fast and accurate editing. You can inspect, clean and view a one-hour program in less than 5 minutes. Variable film speed from zero to 450 feet per minute both forward and reverse. Machine automatically stops at completion. Guaranteed against defects in material and workmanship. Ship. Wt., 235 lbs.

No. 3J101..........................**$3,950.00**

PROTECT-O-FILM

World's Finest Film Conditioner

4-WAY PROTECTION

1. Maximum Scratch Protection
2. Cleans and Conditions
3. Anti-Static Action
4. Kills "Greenness"

Two types of fluids available. Formula 101X is ideal for use on release prints and for continuous projection as well as general purpose cleaning. Formula 201X is a treatment for originals, intermediate negatives and for use in the Protect-O-Film Electronic Cleaning Machine. It is superb for quantity printing from a given negative without degradation of picture quality. PROTECT-O-FILM is completely SAFE. It contains NO Carbon Tet and it's also Non-Flammable.

Size	Type 101X	Type 201X	Price
Pint	10J101	10J121	$ 1.75
Quart	10J102	10J122	2.82
1-4 Gal.	10J103	10J123	9.60
5-54 Gal.	10J103	10J123	9.C0
20 Gal. Drum	10J104	10J124	165.00
55 Gal. Drum	10J105	10J125	395.00

ELECTRONIC CLEANING MACHINE

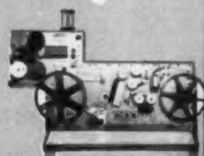
World's Finest Film Cleaner and Conditioner!

The Harwald Protect-O-Film Machine applies PROTECT-O-FILM Cleaning fluid to 16mm film at speeds up to 1000′ per minute. It guarantees excellent 4-way protection. 1 . . . provides cleaning action, 2 . . . prevents scratches, 3 . . . anti-static, 4 . . . knocks "greenness. The cleaning fluid is electronically controlled to provide uniform wetness regardless the speed of the film.

An efficient exhaust is provided to eliminate fumes from the working area. This unit is designed as an attachment to fit any senior type Inspect-O-Film Machine and is controlled by it. Also can be used on a developing machine or bench rewind. When ordering, please specify type of service intended so that the proper type electrical connectors are supplied. Ship. Wt., 100 lbs.

No. 17J103..............**$995.00**

Illustration shows an actual installation used with an Inspect-O-Film (Fits any senior type Inspect-O-Film machine)



CEMENT-O-FILM

The Amazing Lightning-Fast Super-Speed Film Cement

Cement-O-Film is a radically new splicing fluid developed in Harwald's laboratory. Now, for the first time, an instant splice can be made—even without heat! Cement-O-Film not only is lightning fast, but it makes extremely strong long-lasting splices. The reason is a new solvent combination which makes a true weld on even the new triacetate film bases. Just order a pint today and *see for yourself*. Users tell us they save so much time and film, using Cement-O-Film, that they throw out their stock of older type cements. It is absolutely non-corrosive and actually helps to keep your splicer clean.

No. 10J147 One Pint Can..............**$2.95**
No. 10J149 One os. Bottle with Brush... **.50**

The Harwald Co., Inc.
1245 Chicago Avenue
Evanston, Illinois
DAvis 8-7070

HARWALD'S SPLICE-O-FILM

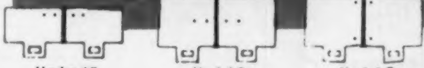
World's finest splicer...

The major cause of film failures is poor splicing . . . and the major cause of poor splicing is improper scraping. SPLICE-O-FILM solves these problems with its electric heat and automatic scraper that takes off exactly the right depth of emulsion every time.

In just 9 SECONDS you can get a perfect splice—accurate within 1/10,000 of an inch. For laboratory use, SPLICE-O-FILM's registration accuracy makes it ideal for A-B roll preparation. (No. 4J106 recommended) and its preset scraper permits reliable splicing of raw stock in the dark. (No. 4J105 or 4J101 recommended).

The new SPLICE-O-FILM is equipped with special features not found on the earlier models. Among these is the Mark III scraper assembly with its extra long life tungsten steel blade which can be changed and adjusted perfectly without tools. You can put this unit on your older Harwald splicers if desired. (Part No. 4S3100............**$12.50**)

The main difference between the Model B and AR are size and pin arrangement. Model B is larger with pins in the center of the bed for fast working with both B-W and color films. AR is indicated where top quality splices are desired at a minimum cost. Model C is for 35 MM only. The Model B 4J105 is our most popular model for film libraries. Ship. Wts., Model "AR" 5 lbs.; Models "B" and "C" 8 lbs.



Cat. No.	Description	Price
4J101	3/16" width splice for prints, 16mm	$ 99.50
4J102	1/16" width splice for negatives, 16mm	$ 99.50
4J105	3/16" width splice for prints, 16mm	$175.00
4J106	1/16" width splice for negatives, 16mm	$175.00
4J107	3/16" width splice for 35MM Film	$175.00
4J108	1/16" width splice for 35MM Film	$175.00

Also available 35MM Micro Film Splicer........**$175.00**

HARWALD'S SEMI-PRO W.C. SPLICER

A dandy small splicer for the amateur who makes an occasional splice and wants the automatic features.

No. 4J205 Ship. Wt., 7 lbs.......................**$199.50**

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from the

HARWALD COMPANY

Visit an exhibit of the world's finest Film Handling Equipment. This is a "convention booth" on paper—for your interest. Also visit us at all the leading Audio-Visual and TV motion picture engineering conventions.
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The Harwald Co., Inc.
1245 Chicago Avenue
Evanston, Illinois
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R. Grunwald
R. Grunwald (President)

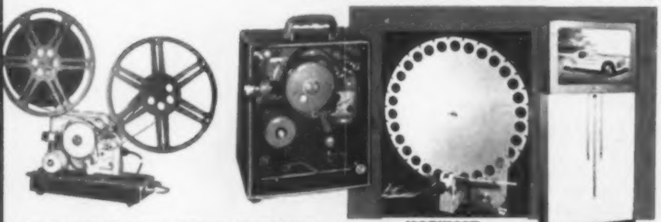
Harwald sells the "influentials" — the leaders in the field who are recognized as smart buyers. Here is a list of people whose deep technical knowledge and whose service to the A-V field have made them established leaders. From experience, they can offer well-based opinions about our equipment. Although space does not permit a full listing of the leading users of our products, here are just a few ...

Social Security Administration
Atlanta Board of Education
Baptist Sunday School Board
Gospel Films
Milwaukee Public Museum
Monroe County Library
General Motors Corporation
U.S. Department of Agriculture
Arlington County Schools
Province of Saskatchewan
Viewsound Supplies
Cartwright Schools
Alhambra Schools
Encyclopedia Britannica Films, Inc.
LaMesa Spring Valley City Schools
San Diego City Schools
San Diego County Schools
Greenwich Board of Education
Los Angeles County Schools
Swift Motion Picture Laboratory
Lederle Labs
University of Washington
University of Colorado
U.S. Air Force Film Library
Armed Forces Radio & Television
Association Films

We invite you to join this group yourself.

In territories where Harwald is represented by dealers, these men are known as the top men in the field, whose judgement is highly regarded.

"Research and Engineering for Finer Film Handling Products"



MM SUPREME 16mm SOUND PROJECTOR

A highly successful unit designed for educational, industrial and entertainment use. It is compact, rugged, easy to carry, yet it performs with more massive and higher priced projectors. The MM Supreme has automatic *safety* trips which make film damage virtually impossible ... even with non-professional operators. It has a self contained screen for desk-top presentations. Film capacity 2000 ft. 105-125 volts, 25-60 cycle AC-DC. Weighs only 28 lbs.
No. 9J101 Ship. Wt., 30 lbs. $349.50

MOVIE-MATE AUTOMATIC REPEATER
16mm Sound Projector for Sales Use

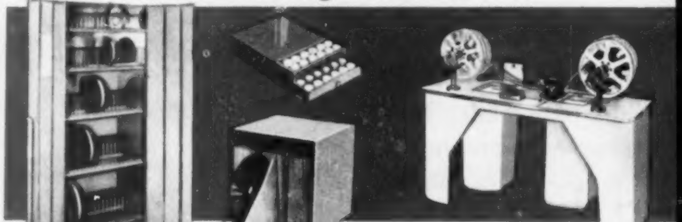
A newly developed, highly reliable compact projector that requires no threading or rewinding. Accommodates 400 feet of continuous 16mm film. Only a flip of the switch is needed for an extremely effective and simple presentation. For 105-125 volts, 25-60 cycle AC-DC. Weighs only 23 lbs.
No. 7J104 Ship. wt., 26 lbs. $498.00

HARWALD DISPLAY PROJECTORS

ADMATIC is a continuous slide projector, that will give your product or story the impact of Kodachrome slides. Thousands of Admatics have been in use for a 12-year period. It is considered the "workhorse" of the advertising field. Ideal at conventions, trade shows and in your outer office. The mechanism is ultra-reliable and rarely requires service. Slide capacity 2"x2", projection size 16"x23", time every new slide shown, 6 seconds. Height 66", Depth 18", Width 28", Ship. Wt., 160 lbs.
No. 5J102 .... $495.00

SONOMATIC is a continuous sound slide projector. It has all the features of the above unit, however it has fully synchronized sound. Ideal for showroom, convention or museum displays. The Sonomatic uses continuous magnetic tape for sound track and control. 1000 cps. inaudible tone controls slide change. Starts with push-button in front and presentation ends automatically. Tape size, ¼", tape cartridge capacity, up to 30 minutes. Ship. Wt., 175 lbs.
No. 8J101 .... $895.00

CINEMATIC is a continuous sound motion picture projector. Styled same as above units. Its excellent picture quality and dependability provides an ideal display or daylight classroom projection. Built-in 800 ft. capacity magazine. Film size, 16mm. Lamp size, 750 watts. Ship. Wt., 190 lbs.
No. 7J101 .... $1,195.00



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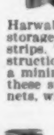
Harwald supplies a complete line of top quality storage cabinets for discs, tapes, films and film strips. These units are of double welded construction and hold a maximum of materials in a minimum space. For full information about these superior, yet competitively priced cabinets, write for complete catalog.

"PREMIER" EDITING BENCH

Functionally engineered & endorsed by world's leading editors. The finest professional bench made. Check these features: Spacious top—Formica Surface—Polished Stainless Trim—Modern Style—Cloth Bins on both sides of built in light box with slide cover lids.
No. 13J102 Ship. Wt., 170 lbs. $289.00

PROJECTION STANDS—another plus product

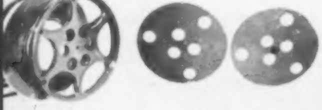


The *High* Stand—that projects over heads—yet folds for easy storage and rolls smoothly. This amazing stand is 51" high—projects right to the middle of a 45x60 tripod screen! Made of rugged steel, yet light weight. Deluxe & Premier have special levelling feet, rock solid even on irregular floors. These modern grey stands are being specified more and more by leading professional A.V. Directors.

No. 13J103 "Standard" $34.95
(No casters no shelf low priced for fixed installations) 27 lbs.

No. 13J104 "Deluxe" 41 lbs. .. $39.95
(One shelf casters and levelling feet)

No. 13J105 "Premier" $69.95
(Illustrated—the world's finest projection stand) 46 lbs.



Compco Reels

Split Reels

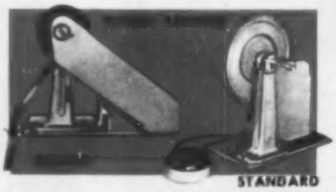
COMPCO REELS are the best projection reels and cans available. They are die formed of hard spring steel and the 800, 1200, 1600 and 2000 foot reels have die-cast aluminum hubs. This ensures that the reels run perfectly true, thus preventing damage to your valuable film.

Cat. No.	Description	Price
12R101	16mm 400 ft. Reel	$ .70
12R102	16mm 400 ft. Can	.70
12R103	16mm 600 ft. Reel	1.65
12R104	16mm 600 ft. Can	1.65
12R105	16mm 800 ft. Reel	2.15
12R106	16mm 800 ft. Can	2.15
12R107	16mm 1200 ft. Reel	2.50
12R108	16mm 1200 ft. Can	2.50
12R109	16mm 1600 ft. Reel	2.75
12R110	16mm 1600 ft. Can	2.75
12R111	16mm 2000 ft. Reel	4.25
12R112	16mm 2000 ft. Can	4.25

QUANTITY PRICES ON REQUEST

HARWALD SPLIT REELS permit you to handle film on cores conveniently, such as leader, replacement sections, negatives etc. We carry a complete line in stock—full listing available on request.

Cat. No.	Description	Price
12R113	16mm Aluminum, 500 ft.	$ 6.00
12R114	16mm Aluminum, 1200 ft.	11.00
12R119	16mm Steel, 400 ft.	4.49
12R120	16mm Steel, 800 ft.	6.15
12R121	16mm Steel, 1200 ft.	7.65
12R122	16mm Steel, 1600 ft.	9.65
12R117	35mm Aluminum, 500 ft.	11.50
12R124	35mm Steel, 400 ft.	5.15
12R125	35mm Steel, 800 ft.	6.40

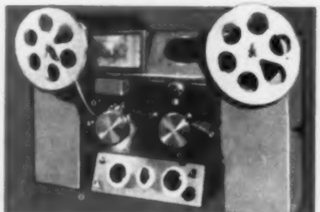


STANDARD

Harwald power rewinds combine unusual convenience in use with economy. One important feature of these units is their very steady speed. Both rewinds take interchangeable shafts and are of 2000 feet capacity. The STANDARD model employs a foot rheostat speed control. The DELUXE model is unusually smooth, stable and works extremely well with sound reader and is absolutely safe for rewinding negatives. It uses a knee operated lever which controls a torque converter. This lever can be locked manually if desired. Other arrangements for speed control are available on special order.

Ship. Wts. "STANDARD" 65 lbs. "DELUXE" 75 lbs.

Cat. No.	Description	Price
19J120	Standard rewind with 16mm shaft	$110.00
19J121	Standard rewind with 35mm shaft	110.00
19J122	Deluxe rewind with 16mm shaft	215.00
19J123	Deluxe rewind with 35mm shaft	215.00



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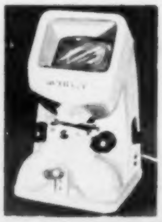
Here's a versatile truly professional editor at a fraction the cost of less convenient competitive equipment. Check these features: Easy to load and use—optical-magnetic sound—big built-in screen—single or double system—transistorized electronics—professional 3 motor drive—instant reversing—oversize sprockets for easy film loading—portable. The new standard for pros all over the world. For Producers, T.V., and all previewing needs.
No. 15J106 Ship. Wt., 80 lbs. $1.389.00



MOVISCOP VIEWER

Moviscop is the finest 16mm viewer, modified for professional use. Special bearings permit use at speeds up to 450 ft. per minute with sapphire film guide available only on Harwald Moviscop. Fine German optical system gives bright, sharp cool pictures. Ship. Wt., 8 lbs.
No. 15J101 . $125.00

FOOTAGE COUNTER

These precision counters measure *feet* and *frames*. A shoe (included) may be attached permanently to the editing bench. Counter fits into shoe, holding it rigidly, can be easily stored out of way permitting space for other equipment. Uses a 20-tooth aluminum sprocket, a Veeder-Root counter for lifetime service—tops for magnetic film. Ship. Wt., 3 lbs.
No. 18J601 16mm Footage Counter ... $68.05
No. 18J602 35mm Footage Counter ... $68.05

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Personalized, printed and plain—that pays in money saved! You are paying for this prestige builder in lost films, lost advertising and sloppy handling. Printed every 7 inches with 3 lines of copy. Blue is for head of film, Red for tail. To Order, simply send in your wording and join all the progressive film managers.

BLANK LEADER

12J107	16mm white sound perf. (1200' min.)	.01/ft.
12J108	16mm white silent perf. (1200' min.)	.01/ft.
12J109	35mm white pos. perf. (1000' min.)	.0175/ft.
12J110	16mm yellow sound perf. (1200' min.)	.0175/ft.
12J111	16mm yellow silent perf. (1200' min.)	.0175/ft.

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2¢ per ft.	2¢ per ft.	1½¢ per ft.	1½¢ per ft.

*Orders under 5,000' please add $16.70 set up charge for initial order only.

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Education, Industry News

The American Society of Cinematographers has established a Research and Education Committee. Announcement was made by William Daniels, ASC President. Activities of the new committee will include working closely with motion-picture studios, industries, and technicians on long-range programs and developmental work. It will also disseminate information on trends within the motion-picture industry, new equipment, processes, etc. Another of its services will be handling the exchange of technical information between different departments of the major studios with the intent of solving problems and in proving procedures involved in day-to-day production operations. In many respects the work of the new committee will parallel that of the Motion Picture Research Council, disbanded in March, 1960.

Chairman of the ASC Research and Education Committee is Walter Beyer, formerly MPRC staff engineer. Appointment of committee members has been announced. Those presently appointed include Gordon Avil, Mark Davis, George Folsey, Robert Hoag, Winton Hoch, Wallace Kelley, Harold Lipstein, Ray Johnson and Douglas Shearer.

Dr. Albert Narath, President of the Deutsche Kinotechnische Gesellschaft-Germany's professional motion-picture engineering society—was the recipient of his Society's highest award, the Oskar Messter Medal, during the annual meeting of the DKG held in Berlin last April. The award was in recognition of Dr. Narath's many contributions to the art of sound-on-film recording. *Journal* readers will recall that a paper by Dr. Narath on "Oskar Messter and His Work" was published in the October 1960 issue.

The Deutsche Kinotechnische Gesellschaft has followed the same course that the SMPE adopted in 1950 in changing its name to show the addition of television to its field of reference. At its annual meeting held in Berlin last April the Society voted to change its name officially to: Deutsche Kinotechnische Gesellschaft für Film und Fernsehen e.V.

The Brooks Institute of Photography, Santa Barbara, Calif., has been authorized by the California State Board of Education to award the degree of Bachelor of Professional Arts, according to a recent announcement. A special curriculum has been set up to conform with State Board requirements. The Institute also announced the appointment of Russel L. Furse to the post of Supervisor of the Motion Picture Department.

August Heat, a film produced by students in the Department of Theater Arts, University of California, Los Angeles, was given an Award of Merit at the 1961 Vancouver International Film Festival, the only student-made motion picture from the United States thus honored at this festival. It was directed by a graduate student, Martin Zweiback. Both graduate

and undergraduate students participated in the production.

A Seminar on Photographic Instrumentation, sponsored by Photographic Analysis Co., 100 Rock Hill Road, Clifton, N.J., will be held November 14–16. Intended primarily for engineers, scientists and technical photographers, subjects covered will include basic theories and terms of photography, types of film, processing methods, optics, available equipment and techniques. The first two days of the Seminar will be given over to talks by authorities in the various related fields and to round-table discussions, followed on the last day by a workshop stressing new developments and applications.

"Greater World Understanding Through International Television" is the theme, according to plans just announced for the First International Assembly of the Academy of Television Arts and Sciences to be held in New York, November 4–11, 1961. Representatives of all phases of television, artists, technicians and administrators and from various countries throughout the world will participate. Categories of discussion include educational and scientific. Technical subjects on the agenda include Satellite Repeaters for Television; International Color Television; and Tape Standards — Standards Converter. Additional information is available from Academy of Television Arts and Sciences, 30 W. 54 St., New York 19.

The IFIP Congress 62, sponsored by International Federation of Information Processing Societies (IFIPS), will be held in Munich, August 27 to September 1, 1962. The U.S. member of IFIPS is AFIPS. newly formed from the Joint Computer Committee established ten years ago by the AIEE, IRE and the Association for Computing Machinery. The 1962 meeting will continue the activities of the International Conference on Information Processing, sponsored by UNESCO in Paris in June, 1959. Papers presented at the technical sessions will discuss new developments in the data processing field. An exhibit of new equipment will be held. Additional information is available from Charles W. Adams, c/o IFIP Congress 62, 142 the Great Road, Bedford, Mass.

Richard J. Soltys, President of Soltys Productions, producers of technical and industrial motion pictures, has announced plans for expansion. The firm engages in all phases of production, including directing, writing, editing and photography in 16mm and 35mm. Types of films produced include documentary, training, public relations, advertising, TV commercials and military progress reports.

Natural Lighting Corp., of Burbank, Calif., has announced expansion of its manufacturing facilities to accommodate production of the newly developed Fotosure identification camera. A recently constructed building brings the total plant space to 18,000 sq ft.

The new address of the *Central Division* of General Film Laboratories, of Hollywood, is 1828 Walnut Street, Kansas City 8, Missouri.

Producers Service Co. division of Boothe Leasing Corp. has moved from Burbank, Calif., to 1145 N. McCadden Place, Hollywood. A new building covers 6000 sq ft and includes offices, studios and a machine, maintenance and repair shop.

A total of 130 motion-picture theaters throughout the United States are now equipped with Norelco 70mm projection equipment, according to information released by North American Philips Co., 100 E. 42 St., New York 17. Among theaters so equipped are the 1600-car North Star Drive-In in Denver and (recently) the Cheltenham in Philadelphia and the Warner's in Erie, Pa., both Stanley Warner theaters.

A contract between the U.S. Air Force and Magnasync Corp., North Hollywood, announced by D. J. White, Magnasync President, specifies delivery of 300 Model T-1510 recording systems and 141 reproducers. These are now in production. The systems are slated for MATS installations throughout the world The largest of these systems can handle 50 simultaneous aircraft-to-tower conversations on a 24-hour basis.

A television program automation system developed by Visual Electronics Corp., 356

W. 40 St., New York 18, has been installed at WDSU-TV Channel 6, New Orleans. The system uses punched paper tape to control daily program operations. Video and audio signals are switched on the air automatically, projectors are turned on and multiplex mirrors switched according to a predetermined schedule. The system is also arranged to put film projectors and videotape machines in operation a specific number of seconds before broadcast time to stabilize their speeds. An automatic switch then puts the program on the air. This system, now commercially available and designated the Visual 6000, was the subject of a paper by F. Cecil Grace and Charles E. Spicer published in the March 1961 *Journal* (pp. 150–155).

The seven stories of steel and glass of the new physics research building of Eastman Kodak Co., Rochester, N.Y., encloses 200,000 sq ft of floor space, contains more than 200 special rooms designed especially for research in such fields as theory of the photographic process, image structure, optical systems, sensitometry, radiography, sound recording, electrostatics and solid state physica, and can accommodate a staff of about 400 persons. An optical penthouse located on the roof is designed for use in research in problems involving long-range photography and solar radiation. An underground lens tunnel, 160 ft long, 10 ft wide and 10 ft high is designed to maintain a constantly controlled temperature and is planned for use in studies of lens systems.

Precision Laboratories, Division of Precision Cine Equipment Corp., 1037 Utica Ave., Brooklyn, has moved to a new building and is now located at 928–930 E. 51 St., Brooklyn 3, N.Y. The new building, designed by the firm, has been constructed to house its special services as efficiently as possible. The firms activities include the engineering, design and rebuilding of motion-picture and TV lab. equipment.

A plan to combine Ampex Instrumentation Products Co. and Ampex Video Products Co. into one organization called the Northern California Operations Group has been announced by Ampex Corp. 934 Charter St., Redwood City, Calif. Robert Sackman will act as Director of the group. He is presently Ampex Vice-President and Manager of Ampex Computer Products Co. The move has been announced as part of a long-range program of centralization of research and development, and sales and service activities.

Formation of a new company, Soundcraft Magnetics, Ltd., Haddenham, Bucks, England, has been announced jointly by Frank B. Rogers, Jr., Executive Vice-President of Reeves Soundcraft Corp., Danbury, Conn., and Sir Eric Ohlson, Bt., Chairman of the British firm of Airtech, Ltd. Sir Eric will be Chairman of the new firm and F. S. G. Codling will be Managing Director. Immediate plans for the new firm include sale of Soundcraft products throughout Great Britain and plans for the future include production of magnetic tape. The new company was formed to meet "the exploding demand for magnetic tape products in Great Britain," the announcement stated.

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■ In Hialeah, Florida, 51 East 10th Avenue, TUxedo 8-4604

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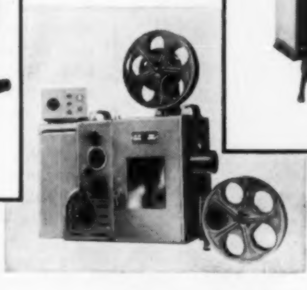
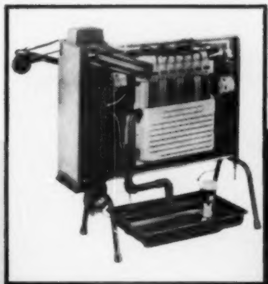
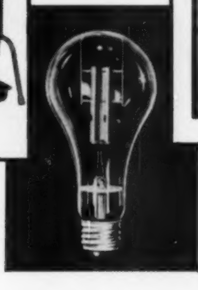
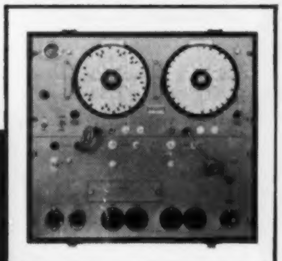








℞ **NEW WADDELL 16-MM HIGH SPEED CAMERA.** A continuous camera employing the rotating prism as the means of optical compensation. Continuous film movement allows film to travel at greater velocities than normal intermittent cameras.

℞ **CECO REDLAKE STOP-MOTION PROJECTOR** 35mm variable speed (8-24 pps), single frame, forward and reverse remote control. 1000 ft. reel capacity.

℞ **CRAMER CONTINUOUS 16MM FILM PROCESSOR** Fully automatic, can be operated in broad daylight. Compact, portable and economical.

℞ **SYLVANIA FF-33 FLOOD FLASH** Ideal for sequence photography. Long duration. Easy & convenient as flashbulbs. Uses "D" batteries.

℞ **CECO E-109 PROGRAMMING DEVICE** Individually controls up to eight separate electrically operated pieces of equipment at one time.

Authorized Service Center for Beckman & Whitley MAGNIFAX (Eastman High-Speed) Cameras!!

Purchase of a Marconi television outside broadcast vehicle by the Russian Television Authorities has been announced by Marconi Wireless Telegraph Co., Ltd., Chelmford, Essex, England. The vehicle was exhibited during the British Trade Fair held at Sokolniki Park, Moscow. It is equipped with four Marconi Mark IV TV cameras.

The Westrex Recording Equipment Division of Litton Systems, formerly located at 6601 Romaine St., Hollywood, has moved to 335 North Maple Dr., Beverly Hills, Calif. The firm's new quarters, adjoining Litton Industries headquarters, occupies 30,000 sq ft. The move was made because of the firms expanding manufacturing and development operations.

Multilingual Sound Installation at the Palace of Science, Brussels World Fair

By GEORGE F. VAN WEYENBERGH

In 1958 at the Palace of Science in the Brussels World Fair, it was desired to tell the story of the atom, describe its structure and give an understanding as to how the electrons, protons and neutrons operate.

Presented on May 10, 1961, at the Society's Convention in Toronto by Austin B. Cooley for the author, George F. Van Weyenbergh, Westrex Company France, 16 Place des Martyrs, Brussels 1, Belgium. (This paper was received on April 10, 1961.)

The problem was to present this story in 30 minutes in five different languages accompanied by pictures, and to be able to repeat this presentation many times. Music and sound effects as well as the multilingual commentary were to accompany the pictures.

It was decided to use 35mm film. Music and sound effects were reproduced from a separate 35mm film over three sets of speakers, one at the front and another at the rear of the ceiling and the third on the stage. The multilingual commentary was piped to outlet boxes attached to the arm rests of the 600 seats of the auditorium.

Five machines were installed. Two provided pictures, using standard Century projectors with anamorphic lenses, Ashcraft lamps and rectifiers and Westrex R-2 reproducers. The other three machines were Westrex sound reproducers using standard 4-track magnetic film. To present the show, one projector was used for the picture and two 4-track magnetic reproducers for the sound. Three of the total of 8 tracks were used to present the music and sound effects over the auditorium speakers. The other five sound channels reproduced the English, French, German, Flemish and Spanish language commentaries. This left one spare picture projector and a spare 4-track sound reproducer for emergency protection.

All five machines were equipped with nonsynchronous and selsyn motors to enable complete interlock operation. A separate amplifying system was provided for each of the four tracks on the three sound reproducers. Patching was provided to enable switching between amplifiers and reproducer tracks. For the picture presentation the arc lamps were operated at 125 amp. The picture was 66 ft in width, and aspect ratio 1 : 2.66 on a perlux screen.

The earphones were of the type used in the U.N. halls in New York: single receiver with removable plastic case which can be slipped over the ear. This was desirable not only as regards cleanliness but also because the cases allowed the choice of either right or left ear. The cord was plugged into any one of the five jacks mounted in a box fitted to the left arm of each of the 600 seats of the auditorium. A potentiometer in the box enabled the listener to adjust the volume.

All earphones used for the five language commentaries were put in parallel. Despite the rough handling the system had to withstand during the six months of its use, no trouble was experienced. All the feeders to the seats could be disconnected in the projection booth so as to isolate any one feeder in which trouble might develop.

Each language circuit was loaded with an 8-ohm resistance across the line. Thus, any number of 2000-ohm earphones could be used up to a resultant 8-ohm impedance, using the 4-ohm output of the 26C amplifier. Regardless of the number of earphones in use for any particular language no noticeable mismatch was encountered.

A Bilingual Drive-In Installation

By FRANCESCO De RENZIS

The Metro Drive-In opened in 1958, in Rome, Italy, was the first drive-in theater to install bilingual equipment. With this equipment either the Italian dubbed version or the original (usually in English) may be selected. In 1959, another drive-in, the Motocine in Madrid, Spain, installed similar bilingual equipment. The ability to provide dual-language versions is important in view of the great number of English-speaking tourists visiting Rome and Madrid and the number of U.S. personnel stationed in or near these two cities. The Rome Metro Drive-In has a capacity of 800 cars; it covers an area of approximately 14 acres. The parking area is divided into 17 ramps, eight of which have been wired with power distribution to supply in-car heaters during the winter.

The facilities include a snack bar and boxoffice. Six hundred seats are reserved in the grandstand for motorcyclists. There is also a playground for children. The screen tower (Fig. 1), constructed in reinforced concrete, is 68 ft high and 125 ft wide. This screen is tilted 5° and curved on a 755-ft radius. It is the largest screen in Europe. The projection booth is placed on the ninth ramp. The projection distance is about 450 ft.

Presented on May 10, 1961, at the Society's Convention in Toronto, Canada, by Austin G. Cooley for the author, Francesco De Renzis, Westrex Company, 19 Piazza Margana, Rome, Italy.
(This paper was received on April 19, 1961)

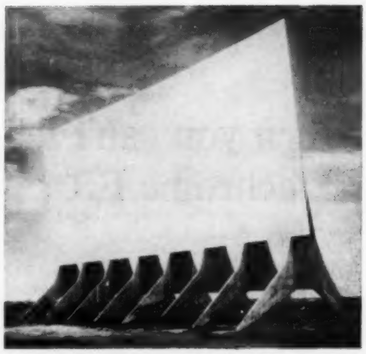


Fig. 1. Screen tower of the Metro Bilingual Drive-In- Rome.

The Italian language sound version is the standard photographic track of the release print and the original language version is a magnetic re-recorded soundtrack on a separate 35mm film. To reproduce simultaneously the two soundtracks for bilingual transmission, each Westrex R6A photographic reproducer is mechanically interlocked with an R-8-B magnetic sound reproducer for standard track reproduction (Fig. 2). The mechanical coupling, incorporating Century helical gears and ball bearings, is used only during the starting period as the magnetic reproducer and the projector are driven by separate synchronous motors.

A special panel, installed on each projector pedestal, simultaneously controls the projector and magnetic reproducer motors, operates the arc rectifier, and can reset the fire alarm circuit. As a safety precaution, a pushbutton, installed on each reproducer pedestal, is used to stop both the magnetic reproducer and the projector and to turn off the arc rectifier. When synchronous operation is not required, the mechanical coupling can easily be disconnected and the motors controlled separately from the same control panel. To facilitate alignment of the mechanical couplings, a special adjustable pedestal for the R-8-B reproducer was designed. Projectors and reproducer pedestals are fastened on heavy iron frames and secured to the booth floor in order to minimize mechanical vibration. A two-way Neumade Synchromaster assembly is used to speed the rewind operation and to make the synchronization easier in case of breakage of one of the two films.

The outputs of the magnetic and the photographic reproducers feed into a preamplifier cabinet installed on the front wall of the projection booth. This cabinet contains two sets of photoelectric cell and magnetic preamplifiers, the photographic and magnetic volume controls, the changeover pushbuttons, and an emergency switch.

Two separate power units, one for each set of preamplifiers, are provided. With the single changeover pushbutton, the magnetic heads and the exciter lamps are switched and the preamplifiers' outputs muted to eliminate clicks and other annoying noises during the changeover period. The magnetic and photographic low level outputs feed into the input panel of the main transmission equipment.

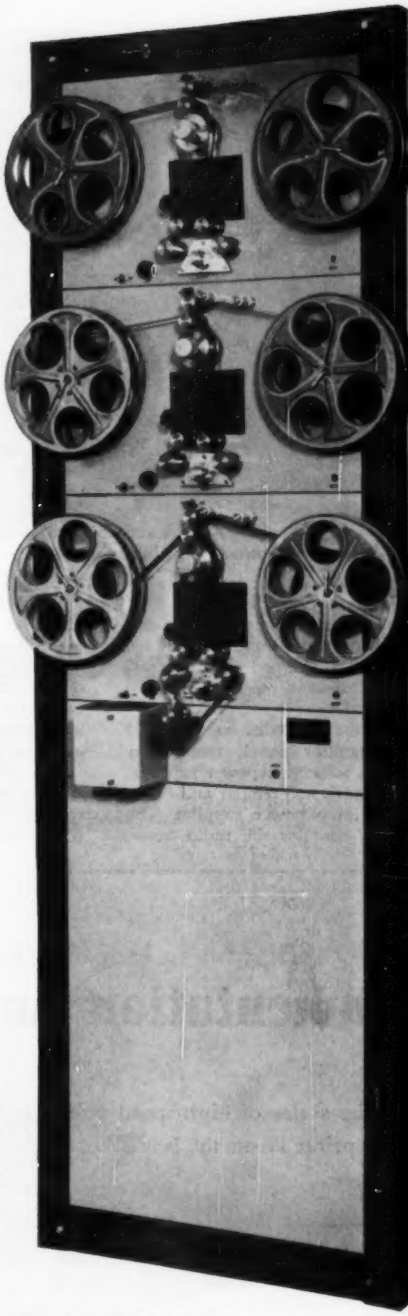
MAGNA-TECH ELECTRONIC 400 SERIES FILM RECORDING EQUIPMENT ARE VARIOUS INSTRUMENTS SPECIALIZED TO PERFORM THE FUNCTIONS ASSOCIATED WITH THE PRODUCTION OF OPTICAL AND MAGNETIC SOUND FOR MOTION PICTURES. THEY OFFER SPACE AND CAPITAL INVESTMENT SAVING WITHOUT COMPROMISING THE CRITICAL DEMANDS OF THE ENGINEER.

The transport is a self-driven unit *incorporating the film pulling mechanism, a miniaturized semi-conductor reproduce amplifier, drive motor and torque motors in one assembly. Basically a magnetic reproducer, it is also used as a magnetic recorder, optical reproducer, and optical recorder by means of optional attachments.*

A cabinet can be supplied to *house five complete film reproducers or various optional attachments and transports utilizing the 77" panel space. A semi-conductor power supply mounts inside this cabinet.*

Interlock is provided by the *conventional method using a selsyn motor mounted on each film transport. 2 to 8 track reproducers and record attachments are also provided. 8 reproduce amplifiers are mounted on one panel. Recording amplifiers are on individual panels.*

Because of quality materials, *quality workmanship, and integrity of design, together with the performance and stability, the Series 400 has a complete range of application in every phase of production of sound for films.*



VIEW OF THREE SERIES 400, TYPE MD497 DUAL FILM WIDTH, 17½mm AND 35mm MAGNETIC REPRODUCERS, AND ONE OD435, 35mm OPTICAL REPRODUCER ATTACHMENT INSTALLED IN THE CS400 CABINET.

WRITE FOR 12 PAGE BROCHURE

TYPE	FILM WIDTHS	SPEEDS(fpm)	OPTIONAL ATTACHMENTS ACCOMMODATED		
MD416	16mm	36	MR416 MAGNETIC RECORD	OD416 OPTICAL DUBBER	OR416 OPTICAL RECORD
MD417	17½mm	90	MR417 MAGNETIC RECORD		
MD435	35mm	90	MR435 MAGNETIC RECORD	OD435 OPTICAL DUBBER	OR435 OPTICAL RECORD
MD447	17½mm	45	MR447 MAGNETIC RECORD		
MD437	COMB. 17½/35mm	DUAL 45/90	MR437 MAGNETIC RECORD	OD435 OPTICAL DUBBER	OR435 OPTICAL RECORD
MD427	17½mm	DUAL 45/90	MR427 MAGNETIC RECORD		
MD497	COMB. 17½/35mm	90	MR437 MAGNETIC RECORD	OD435 OPTICAL DUBBER	OR435 OPTICAL RECORD
MD436	COMB. 16/35mm	DUAL 36/90	MR436 MAGNETIC RECORD	OD416 AND OD435	OR416 AND OR435

M.T.E. MAGNA-TECH ELECTRONIC CO. INC.
630 9TH AVE. N.Y. 36, N.Y.

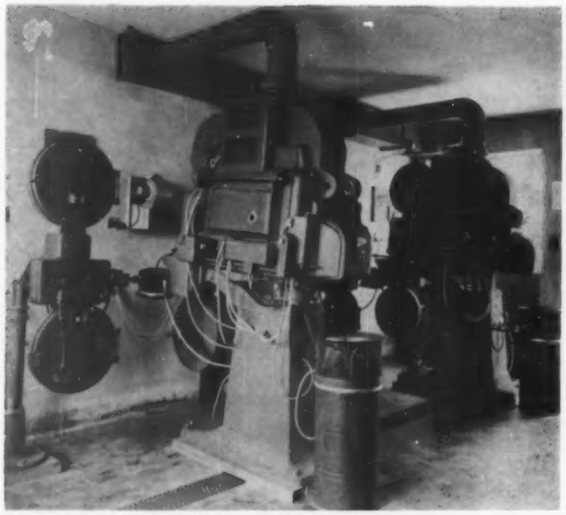


Fig. 2. R & B magnetic sound reproducer.

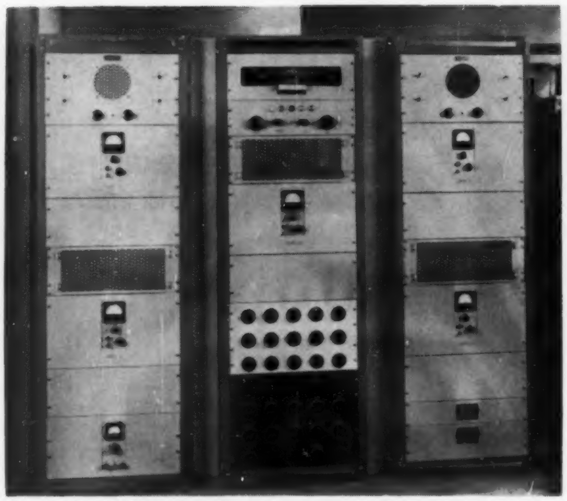


Fig. 3. Transmission equipment.

Transmission Equipment

The transmission equipment, modified for bilingual operation and augmented with some locally designed special accessories, is installed in three cabinets each 5½ ft high (Fig. 3).

The first cabinet contains one modified output and monitor panel, two power amplifiers with associated power supplies, a ventilating panel, and regular and emergency exciter lamp power supplies. The second cabinet contains the radio tuner, the input switching panel, one power amplifier and associated power supply, a ventilating panel and the ramp switchboard panel. The third cabinet houses one output and monitor panel, two power amplifiers with associated power supplies, a ventilating panel, and the regular and emergency preamplifier power units.

Two 200-w power amplifiers in the first cabinet serve the Italian language in-car speaker distribution bus; two similar amplifiers are in the third cabinet. One of these amplifiers serves the original language bus and the other serves the speakers installed in the grandstand, snack bar, and manager's office. The fifth power amplifier, located in the second cabinet, is for emergency purposes and can be substituted for any one of the other four amplifiers by operating the input panel emergency switch and the output emergency switch of the defective amplifier. Two of these latter switches are installed on each output panel.

The input panel (center cabinet, Fig. 3), in addition to the 5-position input emergency switch, contains the nonsynchronous volume control as well as volume control for the grandstand, snack bar and manager's office speaker, and a 6-position input switch. This switch operates as follows:

First position—the photoelectric cell preamplifier drives the four power amplifiers when only the photographic soundtrack is to be reproduced.

Second position—the preamplifier drives the Italian version power amplifiers. (The magnetic preamplifier drives the original version power amplifier when the Italian language is on the phototrack of the release print and the original on the track of the magnetic film.)

Third position—the second position connections are reversed if the original is on the phototrack and the Italian on the magnetic track.

Fourth position—all power amplifiers are fed by the radio tuner.

Fifth position—the manager's office microphone preamplifier drives all power amplifiers.

Sixth position—a tape reproducer preamplifier feeds all power amplifiers.

The output switchboard panel switches the original and Italian sound distribution systems of each ramp and the grandstand, snack bar, and manager's office sound distribution lines. This panel contains 35 4-position, 2-pole, make-before-break switches, the first position of which is "off". Dummy load resistances are not required because the power amplifier has a 14 to 1 output damping factor and can work into a load resistance of infinity without going into oscillation. A 3-kva voltage regulator feeds the a-c to the transmission equipment and a 6-kva power transformer supplies the in-car speaker controls and the concession and signal lights.

Amplifiers

The main amplifier has a continuous power output rating of 200 w with a harmonic distortion of less than 1% over a frequency range of 20 to 20,000 cycles and a peak power rating of 400 w with not more than 1% harmonic distortion.

To minimize the crosstalk interference between the Italian and the original sounds, each distribution system has been wired with separate twisted-pair ground balanced conductors. As the 25-ohm output (70.7 v standard) of the power amplifiers has no center tap, center-tapped retardation coils with a low d-c resistance and a high inductance winding were connected in parallel to the power amplifier outputs and with the center tap grounded to balance the outputs.

The in-car speakers are made by Westrex Company Ltd. in London and are equipped with coiled cords. The outdoor loudspeakers were designed and manufactured in Italy for this installation. The speaker controls have been modified to incorporate two matching transformers (one for each of the two in-car speakers), two terminal strips, and two DPDT (double pole, double throw) switches to select the Italian or the original sound distribution system.

Century CCW double shutter, curved gate, water-cooled mechanisms are used in combination with Ashcraft Super-Cinex arc lamps and Bausch & Lomb 4-in. lenses to obtain the maximum light efficiency. Century heavy-duty pedestals and 18-in. magazines, zipper changeovers, Ashcraft 1612 type rectifiers and water recirculators, and Dayton blowers for the exhaust ducts are the necessary accessories which complete the installation.

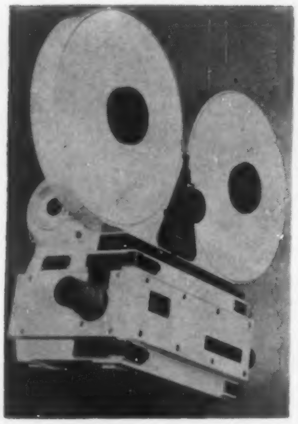
Positive 13.6-mm × 18-in. and negative $\frac{7}{16}$-in. × 9-in. National Carbon trims are used with an operating range of 120 to 150 arc amperes. The lower current is used for black-and-white films and standard-size aperture plates; the higher current is used for CinemaScope and MetroScope.

Because of the poor voltage regulation of the main power supply, and to facilitate the handling of the various arc currents required for the different types of films projected during a single show, a 6-position 3-pole commutator switch is used instead of the customary strapping of the "Y" center of the primary winding of the rectifier power transformer.

To comply with fire prevention regulations, an electromechanical safety circuit has been included in the projector to prevent the projectionist from opening the arc-lamp dowser with the mechanism stopped. Projection porthole glasses have been eliminated to minimize light absorption. Blowers were installed to prevent dust from entering the projection room.

new products
(and developments)

Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.



The WF-30 Fastax 16mm high-speed camera has been announced by Wollensak Optical Co., 850 Hudson Ave., Rochester 21, N. Y. Produced after nearly two years of research and development, one version of the camera incorporates an RFI (Radio Frequency Interference) protected oscillograph for high-speed oscilloscopic recording. The camera has a 1200-ft capacity, darkroom loaded, "T" core magazine. The variable speed range is controlled by a solid state loop servo device for rapid acceleration and regulated operational velocity within ± 4% of the preselected rate. The lens is a rotating prism-sector shutter combination. Through-the-lens viewing is provided for picture composition and focusing. Features include timing markers, electrical interlocks, "ready" lights, speed indicators, footage counter and, standard 115 v a-c 60-c power input. The camera can also be used with most of the Fastax bayonet-type lenses.

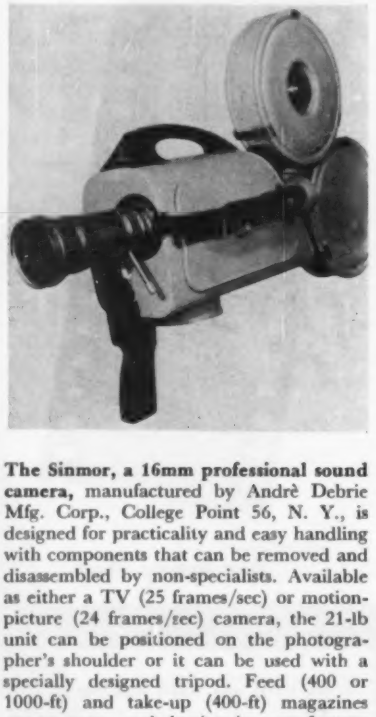
A rapid automatic film titling unit, developed by Eastman Kodak Co. in cooperation with Xerox, Inc., and Photo-mechanisms, Inc., for Melpar, Inc., is part of a complex, electronic, ground data-handling system for the Convair B-58 Weapons System. Installed at Convair, Fort Worth, Texas, the equipment is used to title negatives of aerial photographs immediately after processing at rates from 15 to 25 ft/min. The data-handling system employs a battery of cameras linked electronically to instruments in the aircraft. When photographs are taken of radar screens in the aircraft and of the terrain as observed in reconnaissance flights, a binary time code is recorded on the margin of the film as well as in the data block of flight information recorded on magnetic tape. This binary code relates each photograph or group of photographs to corresponding information on the magnetic tape. Later, an electronic editing instrument searches for the film time-code that corresponds to that on the tape. When coincidence is found, the information on the proper section of the tape is converted to letters and numbers, held in a memory unit, read out, and placed on the film as a title.

In titling, a cathode-ray tube is used to put images onto the light-sensitive surface of a rotating xerographic drum. The image is then developed and electrostatically transferred to the film emulsion surface where it is fixed by chemical vapor. The equipment accommodates three film sizes; 9½-in., 70mm and 35mm.


DU PONT
DU PONT

An ultra-high-speed Kerr cell camera system designed for hypervelocity particle ballistic range and other multiple station applications has been announced by Electro-Optical Instruments, Inc., 2612 East Foothill Blvd., Pasadena, Calif. The system, designated KSC-20, is designed with few operating adjustments, capacity for multiple station use from one master control center and capability for use with an accessory spark gap source. It will be made available at a lower cost than the firm's more sophisticated KSC-51/A Kerr cell camera system.

The control unit panel is designed to permit operation of as many as five separate stations or modules at the same time. The Kerr cell shutter of the new system is driven from a module identical to that used in the KSC-51 system. Optical and electrical characteristics summarized in the announcement include the following: Exposure time range, 20 nanoseconds to 10 μsec. Shuttering pulse amplitude, 25 kv. Transmission characteristics, open, 0.12 to 0.25 and closed, approximately $10.^{-8}$ Resolution, 1:10,000. Kerr cell aperture, 0.50 in. × 1 in. (small end).

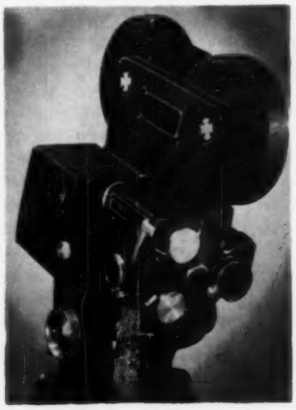


The Sinmor, a 16mm professional sound camera, manufactured by André Debrie Mfg. Corp., College Point 56, N. Y., is designed for practicality and easy handling with components that can be removed and disassembled by non-specialists. Available as either a TV (25 frames/sec) or motion-picture (24 frames/sec) camera, the 21-lb unit can be positioned on the photographer's shoulder or it can be used with a specially designed tripod. Feed (400 or 1000-ft) and take-up (400-ft) magazines are separate, each having its own footage counter; the 400-ft magazines are interchangeable.

The film is pulled past the lens, by high-precision pins, through a "V" channel (Debrie patent) shaped to ensure steadiness and sharp focus. Only one drive motor, which operates from a-c or batteries, is required. The camera is designed to use variable-focus lenses, standard mount, type C Zoom-Angénieux with direct finder to eliminate parallax.

Three magnetic heads provide erasing, recording and control reading of the recording. Advance of sound in relation to the picture is 28 frames ± ½ frame (IEC Recommendation). The magnetic recording amplifier has eight transistors (two for power) and is armored. The recording curve extends from 60 to 8000 cycles and harmonic distortion is less than 1% (CCIR Standard). Measured peak-to-peak, wow is 4% or less and flutter is 3% or less, according to the manufacturer's specifications.

The camera is connected by a 6-ft cable to a control box which contains a start and stop switch for the recording amplifier; amplifier feed by four standard cells; voltmeter for control of the cells; earphone jack connection; potentiometer; and push-button control to permit the operator to listen directly to the sound takes. The camera is priced at $4750.



The Kodak Reflex Special, a 16mm professional camera introduced by Eastman Kodak, has a full-scale variable shutter and is equipped with a reflex viewfinder for viewing through the taking lens while the camera is being operated. A mirrored surface on the shutter reflects the image into the finder. The camera weighs about 24 lb and is of modular construction. The standard drive, a synchronous motor operating at 24 frames/sec, can be interchanged with a variable speed motor, or with a drive unit designed for time/motion studies. Incorporated in the mechanism is a device called a space gate which is designed to prevent binding or scratching of the film by providing clearance of 0.007 in. between aperture plate and pressure pad. The camera is equipped with a 400-ft magazine which can be used with 100-ft or 200-ft rolls of film. Optional equipment includes a 1200-ft magazine. A buckle trip device is incorporated to turn off the camera automatically if the film should not feed properly. A neon monitor light in the remote hand-operating switch shows when power is being delivered to the drive motor. Lenses ranging from 10mm to 150mm, including a 25mm $f/1.4$ Ekton, are available as optional equipment. The unit, which is priced at $1895, is designed so that some future date it can be equipped with a magnetic sound recording system, according to plans announced by the manufacturer.

Recently announced additions to portable processing equipment produced by Rapromatic, Inc., Oak Drive, Syosset,

L. I., N. Y., include the 470, a combination 16mm/35mm/70mm processor; the 100A, a combination 16mm/35mm processor; and the 410 Washer-Dryer, a companion unit for the firm's portable machines for saturated web processing, a system based on the use of chemically saturated paper material. (*Jour.*, New Prod., p. 229, Apr. 1960.)

The 470 is contained in a carrying case, the dimensions of which are 19 by 19 by 9 in. The 30-lb unit has a 400-ft capacity, operates on normal house current (110 v 60 cycle) or it can be manually operated. Average processing time is said to be 50 ft/min. The manually-operated 100A, which weighs 8 lb with overall dimensions of 12 by 17 by 4 in., has a film capacity of 100 ft. The Washer-Dryer, contained in a case measuring 19 by 19 by 9 in., and weighing 26 lb, is said to be capable of drying rates of up to 25 ft/min with prehardened emulsions to commercial retentivity standards. The unit is equipped with a 110 v a-c 50-60-cycle motor which requires approximately 1 amp; a 600-w heater; and a 2-gal static wash tank and squeegees.

A liquid heat-reducing filter for 35/70mm motion-picture projectors, consisting of two Vicor plates with a liquid between them and a hollow outer rim for circulation of cooling water, is said to minimize or almost eliminate lens focus drift by absorbing the long wave infrared which,

otherwise, would heat the lens elements. Announced by D & F Products, Inc., 1350 No. Highland Ave., Hollywood 28, as the result of studies undertaken jointly with the Motion Picture Research Council before the Council was disbanded, the device is ⅞ in. thick with a free opening of 5½-in. diameter to accomodate the beam of any existing arc lamp (mirror or condenser type) used for 35mm or 70mm projection. Field tests have shown that temperatures in the center of a projector gate may go as high as 1600 F. By using the heat filter it is said to be possible to reduce this temperature by at least 30 to 40%.

The Colortran Heat Filter, designed for use with incandescent as well as arc lamps, is a product of Natural Lighting Corp., 630 South Flower St., Burbank, Calif. The filter is constructed of heat-resistant glass covered with a specially developed coating. Tests conducted by the firm are reported as demonstrating absorption of up to 90% of heat rays produced by a light source. The filter is available in a range of sizes up to 20 in. in diameter.

A television projector which projects a 12 by 9-ft color picture onto a screen at a distance of 25 ft has been developed by the Colour Television Laboratories of Marconi's Wireless Telegraph Company Ltd., Chelmsford, Essex, England. The projector accepts separate red, green and blue signals, or a composite coded signal. Video amplifiers with bandwidths of 10 mc/sec feed 5-in. cathode-ray tube projectors, one for each color channel, operating at 50 kv E.H.T. The tubes were specially designed by the English Electric Valve Co. and are associated with Schmidt in-line optical systems, each consisting of a concave glass reflector with an aspherical glass corrector plate which focuses the picture in a flat plane. The three projectors are mounted side by side. Because the center projector is

the only one on the normal to the screen, an electronic correction waveform is applied to each of the outside cathode-ray tubes to avoid keystone distortions of the picture. The firm reports that the projector, first demonstrated in April at the Television and Film Techniques Convention sponsored by the British Kinematograph Society and the Television Society, has been ordered for use in hospitals for display of televised operations and also for certain defense applications.

The ColorTran Cine-Queen and the ColorTran Super-Eighty are two new pieces of lighting equipment announced by Natural Lighting Corp., 630 S. Flower St., Burbank, Calif.

The Cine-Queen (top) is a high-intensity a-c/d-c wide flood using the new General Electric 1500-w lamp. No ColorTran converter is needed because of the preboosted filament construction of the lamp. 1500 foot candle intensity is obtained at 10 ft, with even coverage of a 2½ × 4-ft area.

The Super Eighty (bottom) is a lightweight flood using the R-80 1500-w reflector lamp. When powered by a ColorTran Converter it will illuminate a 7 in. circular area with 940 foot candles at 10 ft. Weight is only 9½ lb. Price of the Super-Eighty is $56. Accessories are available.

A 16mm sound projector, Model 535 Filmosound, announced by Bell & Howell, 7100 McCormick Rd., Chicago 45, weighs only 29 lb and is equipped with a Super Proval 2-in. $f/1.6$ lens for added brightness. Used with the firm's Proximity lamp with built-in reflector the machine is said to project a sharp, clear picture even in a room that is not completely darkened. The lightness in weight has been achieved by the use of magnesium castings, miniaturized electrical components and a case made of glass fiber. Modular construction makes possible easy removal for repair or replacement of individual components. A five-position knob turns the projector on and off and activates the forward, reverse and rewind operations. The price is under $600.

Two remote-controlled, automatic-threading 8mm movie projectors, Touch-Tronic Models 265 and 380, have been announced by Bell & Howell, 7100 McCormick Rd., Chicago 45. Both models have the 3-button (forward, reverse and still) hand unit and 10-ft cord that enables operation from a comfortable distance. Manual controls are also provided. Model 380, which offers variable speed from 14 to 24 frames/sec, is priced at about $184.95. The 265 is priced at about $139.95.

Two CW power tubes which provide convenient and powerful signal sources over the 50 to 60 kmc range have been developed by Bell Telephone Laboratories, Murray Hill, N. J. A 50-mw backward wave oscillator and 0.5-w traveling wave tube, both with permanent magnet circuits, are used to provide versatile signal sources for general laboratory use. The backward wave oscillator operates in the frequency range from below 45 to over 60 kmc. It gives a minimum of 50 mw from 50 to 60 kmc and the output power fluctuates less than 2 db over the same range. The traveling wave tube is a helix-type tube that provides more than ½-w of power from 50 to 60 kmc. The low-level gain is 40 to 50 db and midband and shows a slope of about 6 db across the 50 to 60 kmc band. Power from either tube is said to extend the range of measurements possible at 50 to 60 kmc and to permit the use of levelers, ratio meters and similar devices.

A 16mm motion-picture reversal viewer which can produce a positive image on a television receiver from negative film by electrically reversing the negative image signal into a positive signal is described in *Japanese Motion-Picture Engineering*, pp. 34–37, No. 108, April/May 1961. The device, developed by NHK (Japan Broadcasting Corp.), consists of a projector system which transports 16mm motion-picture film continuously and projects successive still images by means of a rotating prism system. The optical system includes a device for adjusting light intensity to correspond with the density of the negative film. A vidicon camera is operated in source-sync and random interlace with scanning frequencies of 15, 75, kc for horizontal, 50 or 60 cycles/sec for vertical and resolution of more than 350 lines for horizontal and 250 lines for vertical.

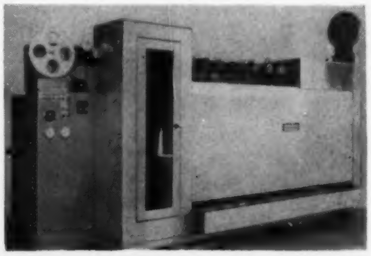
A device for viewing a still photograph as a positive image from 35mm negative is a product of Canon Camera Co., Inc., 312 Shima-Maruko-cho, Ohta-ku, Tokyo. The device is connected on one side to the antenna terminals of the TV receiver and on the other to a 110-v power source. The device also magnifies the image.

3D-TV without glasses is approached through a device called a Stereo-Hood produced by Stereotronics Corp., 1717 N. Highland Ave., Los Angeles 28. This device fits on the television receiver. The Stereotronics System, designed especially for industrial television, consists of a Stereo-Captor that fits on the TV camera lens and a Stereo-Screen that replaces the glass plate in the receiving monitor. Stereo-Glasses are supplied for group viewing and the Stereo-Hood for individual viewing. The Stereo-Hood is priced at $450 for a 14-in. screen size.

Remote control panels which operate in conjunction with Projectomatic, an automatic programmer, have been installed by Rank Precision Industries Ltd., 37–41 Mortimer St., London W.1, England, in six motion-picture theaters in London. Automatic programming and the use of xenon lamps which burn without attention frees the operator to watch the screen as a member of the audience. The remote-control panel enables him to make promptly any necessary adjustments to improve the picture or sound quality. Shown above is a Gaumont Kalee 21 projector, which employs xenon lamps, large capacity reels and Projectomatic, adapted for remote control of focus and framing by the addition of the two units shown attached to the front.

A Compressor-Amplifier designated Model No. 31 has been developed by Magna-Tech Electronic Co., 630 Ninth Ave., New York 36, to permit compression of dialogue or music tracks without causing detrimental distortion to the program. The unit incorporates a solid-state variable gain device and a two-stage push-pull audio amplifier on one chassis. Designed specifically for use in stationary installments, the power supply, meter and attenuators of an existing console can be employed for the compressor. A 16-pin connector provides convenient plug-in connection of power, input and output, and meter. The compression ratio is 20:10, features include de-essing equalization from 0 to 10 db at 10 kc, variable release time from 50 msec to 1 sec and an attack time of less than 1 msec. An optional accessory is available for increase of input and output levels. Model No. 31 is priced at $650.

Three sizes of Conelites in addition to the 1000 or 2000-w Junior size have been announced by Mole-Richardson Co., 937 N. Sycamore Ave., Hollywood 38. The lighting equipment, used mainly for fill lights, is now available in sizes accommodating 500, 750 or 5000-w globes.



A new 16mm reversal film processor, the R-36, has been announced by Filmline Corp., Milford, Conn. Processing rate is said to be 2160 ft/hr for negative-positive film. Features of the R-36 include an overdrive film transport system that automatically compensates for elongations and keeps tank footage constant; automated processing; daylight operation on all emulsions; Temp-Guard temperature control system; variable-speed drive; film speed tachometer; 316 stainless steel construction; two developer pumps; built-in air compressor; bottom drain valves and drain trough.

An electric dimmer with a silicon-controlled rectifier has been introduced by Tokyo Shibaura Electric Co., 1-Chome, Chiyodaku, Tokyo, Japan, manufacturers of equipment under the trade name of Toshiba. Designed for one-man operation with pushbutton controls, the new dimmer has a 10 kw capacity. The use of transformers is not required; with the silicon-controlled rectifier, the voltage drop is only 1.5 v. The new system is said to eliminate "lamp singing" and is thus acceptable for television use.

A new fuel cell which directly converts heat to electricity at efficiencies exceeding

50 percent has been developed by the Armour Research Foundation, Illinois Institute of Technology, 35 N. 33 St., Chicago 16. The significance of this development is not so much that heat has been converted to electricity—that has been accomplished before with efficiencies achieved of up to 12 percent—but that the new fuel cell's 50 percent efficiency brings considerably nearer extensive use of this power source. Perfecting this type of fuel cell may render obsolete turbines and generators, as the cell operates on heat from the sun, nuclear sources or from waste heat sources.

The newly developed cell uses a prepackaged chemical system which can be easily transported, and which may be in the (perhaps) near future launched to the Moon and other planets.

The cell involves essentially a three-step process. First, the heat converts the chemicals for the generation of electricity. Second, the electrical power is taken off while the chemical is cooling. Third, portions of the spent chemical are regenerated by the heat source and are again available for the generation of electricity. The effect is that of two batteries, one giving off current while the other is being regenerated. Instead of batteries, the system uses liquid electrodes for regenerating spent chemicals while hot chemicals are being discharged and decomposed to give electricity. A constant conversion of heat to electricity results from taking off electricity at one point and regenerating chemicals at another point.

Application of this development to practical use suggests that it may soon be possible for remote areas of the Earth to be supplied with electric power through nuclear energy, a year's supply of power requiring only a few pounds of nuclear fuel. In space applications heat energy from the sun could be converted to supply electricity for power, heat and communications in outer space.

A new motor starter developed by the General Purpose Control Dept. of Westinghouse Electric Corp., Buffalo, N.Y., has no moving parts and was specially designed to minimize extraneous noise on motion-picture sets and in TV studios. The device, called a static starter, uses a silicon-controlled rectifier as the main power switch. Termed a "Trinistor" device it blocks conduction in the reverse direction while providing control of conduction in the forward direction. It can be used with 20-hp motors "across-the-line" and with motors of up to 75 hp with reduced voltage starting.

Direct amplification of ultrasonic waves in a piezoelectric semiconductor crystal has been reported by Bell Telephone Laboratories scientists. The soundwaves are amplified by interaction with electrons drifting in the crystal by a process similar to the amplification of electromagnetic waves in a traveling wave tube. Discovery of the principle and its experimental verification was announced by D. L. White, A. R. Hutson and J. H. McFee in the September 15, 1961, issue of *Physical Review Letters*. They achieved amplification of an ultrasonic wave traveling through a crystal of cadmium sulfide (CdS) by applying a d-c electric field in the direction of wave propagation. Gains of 18 db in a 15-mc wave were observed and of 38 db in a 45-mc wave traveling through a 7-mm length of CdS. The amount of amplification obtained depends on the applied voltage and the conductivity of the material. The experiment suggests a new class of solid-state electronic devices such as amplifiers, oscillators, delay lines and isolators based on the combination of piezoelectricity and semiconduction in certain crystals.

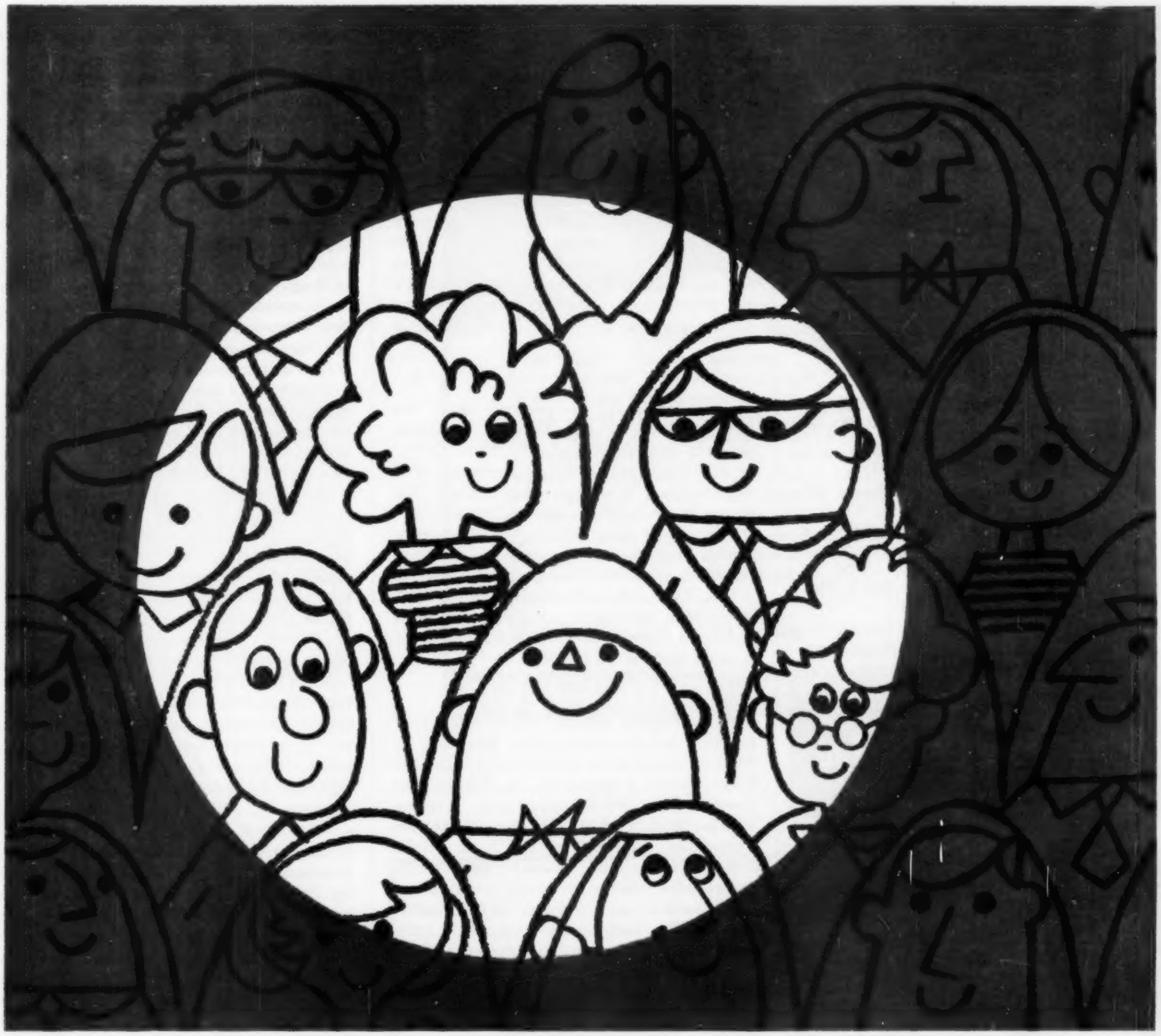
A dual-speed hysteresis synchronous motor designed to drive large inertial masses at a constant rate of speed has been announced by Beau Electronics, Inc., Waterbury, Conn. The design of the a-c motor, designated the Type 5003, is based on an unusual "inside-out" principle of construction, so described because the rotor revolves around the outside of the stator with the motor ring acting as a permanent magnet and the poles shifting as frequency varies. The purpose of this design is to increase the moment of inertia with resultant advantages in torque and stability. The motor is said to have a stable output of 300 or 600 rpm, insensitive to voltage changes.

Tests conducted by the manufacturers show the motor to be operable within a temperature range of -65 to $+165$ F; input voltage 115 v single phase, variable 40 v in either direction; power input 28 w maximum; and continuing operation possible of more than 10,000 hr with maximum unbalance remaining at 0.004 oz in.

Designed as a direct drive for high-fidelity audio tapes and tape recorders, other applications suggested by the manufacturer include video tape, data tape, remote controlled missile stations, astronautical devices and infrared scanning systems. The motor is priced at $95.

A wide-range harmonic marker generator, said to be capable of producing birdie markers up to several hundred times its fundamental oscillation, has been introduced by Telonic Industries, Inc., Beech Grove, Ind. The device, called the CDH-0.1 Harmonic Marker, uses three tubes and two crystal diodes and is supplied as a plug-in unit. The accuracy of the crystal is reported at $\pm 0.005\%$. Designed primarily for use with Telonic sweep generators, the unit is plugged into the sweep generator and produces harmonics of the sweep sample via frequency multiplication. The resulting harmonics are mixed with a portion of the swept signal to create audio beats which are then superimposed upon the display across the sweep range. Available with various crystal frequencies ranging from 0.1 to 100 mc, the price range is from $55 to $75.

Seamless Mylar (DuPont TM) belts, custom made and precisely dimensioned to the purchaser's specifications have been announced by Kinelogic Corp., 1256 North Fair Oaks Ave., Pasadena, Calif. Designed for flutter-free and slip-free precision power transmission in the fractional and subfractional horse-power range, the



belts are made in lengths to 48 in., widths to 1 in. and thicknesses from 0.5 to 10 mils. Tolerances are as low as 0.015 in. on length, 0.0001 in. on thickness and 0.005 in. on width. Descriptive literature and technical design data are available from the firm.

A micro-adapter introduced by Karl Heitz, Inc., 480 Lexington Ave., New York 17, is used to attach the Camex 8mm single lens reflex motion-picture camera to any microscope. For microcinematography the microscope's eyepiece is replaced by the adapter tube. The device is priced at $4.95.

A two-terminal component used for limiting current in electrical networks has been announced by CircuitDyne Corp., a subsidiary of Telonic Industries, Inc., 480 Mermaid St., Laguna Beach, Calif. The device is a solid-state unit called the Currector. It is available in fixed current ratings from one to 10 milliamp in 10% increments. Standard current tolerance is ±5%. Typical admittances are as low as 1 micro-ohm and both polarized and nonpolarized versions are available. The price range is from $6.30 to $32.

New bandpass filters, series FBH 102, covering the frequency range from 255 to 3655 cps, have been announced by CircuitDyne Corp., a subsidiary of Telonic Industries, Inc., 480 Mermaid Ave., Laguna Beach, Calif. Toroid coils are adjusted to inductance tolerance of ±1% to attain sharp filter cutoff characteristics while maintaining maximum power capabilities. The insertion loss is reported at 6 db maximum. The bandwidth is approximately 10% to 30% of center frequency at the 3 db down point. Source and load impedance is 600 ohms for standard versions, but other impedance values are available.

The production of semiconducting diamonds—one of the rarest of all gems—has been announced by General Electric Research Laboratory, Schenectady, N.Y. The process by which these man-made gems are made involves subjecting a mixture of graphite and catalyst to which boron, beryllium or aluminum has been added to pressures of about 1 million lb/sq in. and temperatures above 2000 F. The Laboratory has also made semiconducting borazon, a cubic form of boron nitride, which has a structure similar to that of the diamond.

A chemical method for rapid and continuous growth of crystalline niobium-tin has been developed by the RCA David Sarnoff Research Center, Princeton, N.J. This compound is a superconducting material recently found to possess the ability of generating and sustaining very strong magnetic fields without any power dissipation. Until development of the RCA process any extensive use of this material was impossible because of its brittleness. Laboratory equipment developed for this purpose is capable of producing uniform crystal coatings of niobium-tin on a fine wire at a rate of 30 ft/hr. Extension of this method suggests widespread practical use of simple superconductive magnets, using no power, to generate enormous magnetic fields for large nuclear research machines and for ultrasensitive receivers used in radar, radio astronomy and space communications.

A television system installed in a helicopter to cover the World Championship Unlimited Hydroplane race in Seattle held in August was designed by KIRO-TV for its newscast of this event. Announced as the "smallest and lightest-weight" TV system to be used by a commercial station within its particular range, the main design problems were how to fit a camera chain, transmitter and transmitting antenna into the helicopter while keeping under the weight limit of 250 lb and how to compensate for the limitation of available primary power. The ground equipment included a receiving antenna and receiver. To save power, the camera chain was fitted with an optical rather than an electronic viewfinder, and a transistorized camera chain with self-contained batteries was used. A transmitter was designed which operated on 24 v d-c. The transmitting antenna was of the inverted quarter-wave ground plane type. A large ground plane eliminated the problem of reflection from rotor blades. The system was found to give excellent coverage of an area more than six miles in diameter, which proved sufficient for detailed TV coverage of the hydroplane races.

A new type of connector with the appearance of a coil spring has been developed by Bell Telephone Laboratories for connecting plastic insulated small-gage wires to terminals, designed mainly for use in telephone terminal boxes. The new connector permits wires to be connected rapidly and without first stripping the insulation, and connection and disconnection operations do not disturb other wires connected to the same post. The new connector differs from the coil spring which it resembles in that the spring wire is square-shaped rather than round or oval.

The Dual Electric Eye, a device developed by Bell & Howell, 7100 McCormick Rd., Chicago 45, is used to achieve correct exposure for the subject of a backlighted scene by compensating for the reflection of the sun's rays into the electric eye. Designed with a second photocell to offset the effect of the sun's rays reflected inward from the metal grid covering the electric eye cancels part of the charge generated by the main cell by sending current into the meter from the opposite direction. The new device has been incorporated in the cameras in the firm's Zoomatic series.

Yttrium iron garnet (YIG), a material that provides a substantial improvement over ferrites in many electronic applications, has been the subject of exhaustive studies by Bell Telephone Laboratories, which reported findings of the studies in a paper by R. C. LeCraw and E. G. Spencer presented at the International Conference

on Magnetism and Crystallography held in Kyoto, Japan, during the week of September 18. YIG is similar to the ferrites in that it is both ferrimagnetic and an electrical insulator, but it has a different crystal structure and is a much better insulator. Both types of material transmit microwave radiation with very little loss. Also, when a strong d-c magnetic field is applied to them, they can be made to transmit microwaves in one direction with little loss, but strongly absorb radiation in the reverse direction. The paper on YIG reported observation of YIG ferromagnetic linewidths of only 0.14 oersteds at room temperature and 6000 mc—the narrowest linewidth ever reported for a ferromagnetic material.

The CARon Mobile Power Unit, capable of generating 110-v a-c power from automobile engines, is used as a power source for industrial motion-picture and TV news photography. Availability of the unit has been announced by Gordon Enterprises, 5362 N. Cahuenga Blvd., North Hollywood. The generator is capable of supplying 110-v 60-cycle a-c power for equipment such as motion picture cameras, recorders, and lighting equipment under daylight or nightime conditions in the field. Designed for easy installation on any motor vehicle engine, the generator is driven by the fan belt from the water pump, crankshaft or d-c generator pulleys. A mounting bracket is supplied for engine block installation. A dash-mounted panel contains the on-off switch, volt meter and throttle regulator.

The Model 800 Recording Wave Analyzer is a product of Optron Corp., 335 South Salinas St., Santa Barbara, Calif., and is designed for complete waveform analysis over a frequency range of 20 to 20,000 cycles by measuring the amplitude of all the frequency components in any waveform and recording them on a built-in strip chart recorder. The instrument, contained in a compact unit measuring 18 by 15 by 12 in., has selectivity of 3 db attenuation at $\pm 1\%$ of the tuned frequency, and accuracy of $\pm 3\%$ of the frequency and $\pm 5\%$ of the amplitude.

The PEK 200, a three-electrode, 200-w high-pressure mercury arc lamp, has been announced by PEK Labs, Inc., 4024 Transport St., Palo Alto, Calif. Arc size is 0.100 by 0.070 in. with a total light output of 2500 lm. Operating on a-c or d-c, the lamp is designed for applications such as fluoresence microscopy, projection systems, microfilm duplications, etc. It is priced at $49.

employment service

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Position in engineering department of motion-picture laboratory or equipment manufacturer. Thirty years experience as supervisor in Engineering Department of Consolidated Film Ind., Fort Lee, N.J. Experience includes machine shop, construction and maintenance of printers, developing machines and other film equipment. Also assisted in design and development. Irving Fox, 3214 Kingsbridge Ave., Bronx 63, N.Y.

Free—$45,000 worth of 16mm cameras, lab and sound equipment, when under the supervision of a competent Audio-Visual Director. Over 20 yrs independent supplier of visuals and lab service to industry, government, education and TV. Desires to head and operate audio-visual service for one large responsible organization. Fial Films, 72 Lake Trail East, Wayne, N.J.

Cameraman—Optical Printing Specialist. Long experience Hollywood studios and East Coast laboratories; own bench optical printer assembled with Acme camera (35) and projector (35 & 16) printing Eastman Ektar, 1000-ft bi-pack for masters, plus all accessories, cost $18,000. Seek association with producer or laboratory including equipment at nominal fee or will sell machine at less than half original cost. Last 8 yrs chief optical printing at Consolidated Film Industries, Fort Lee. Will relocate. W. G. Heckler, 21 West 58 St., New York 19. PL 3-7067.

Positions Available

Cameraman. Prefer man with considerable experience on Mitchell cameras. Midwest producer with fine reputation and financial standing wants man with ability and experience in lighting sets and operating camera on all kinds of interior and exterior photographic assignments. Job involves very little travel. Write giving full details of past and present employment and salary expected. Technisonic Studios, Inc., 1201 Brentwood Blvd., St. Louis 17, Mo.

Chemist-Photographic. Civil Service. Grade GS-11. Starting salary, $7560. In Photogrammetry Division, Photographic Service Branch. Involves establishing procedures in controlling quality of chemicals. Mail Form 57 (available at any post office) to Aeronautical Chart and Information Center, Attn. Mr. R. J. Gast, ACDPS, Second and Arsenal Sts., St. Louis 18, Mo.

Electronic Engineer. To supervise Sound Maintenance Dept. of large modern motion-picture studio. At least 5 yrs professional experience in sound recording essential. Thorough knowledge of solid state and tube audio circuits, magnetic and optical sound recording systems, sensitometry and transmission measurement techniques re-

quired. Must have ability to do independent design work on special projects. Administrative experience desirable. Excellent working conditions in suburban Montreal. Send resume, with academic background, to: Personnel Dept., National Film Board of Canada, P.O. Box 6100, Montreal, Que., Canada.

Photographer with broad experience in high-speed cinematography. Must be familiar with 16mm Eastman High-Speed Camera, Arriflex and Cine Special. Knowledge of time-lapse, standard motion-picture and still photography techniques also desirable. Training and experience will determine starting salary in $6000 to $9000 range with excellent growth opportunities in growing in-plant department. All replies confidential. Send resume to: Photography Dept., Corning Glass Works, Corning, N.Y.

Television Broadcast Technician. Group stations offer opportunities for men with initiative and basic knowledge of TV fundamentals. Write G. G. Jacobs, Corinthian Broadcasting Corp., 302 So. Frankfort, Tulsa, Okla.

Exchange Job—TV Cameraman. German TV cameraman in Munich, Germany, TV studio would like to exchange job for 1 yr with TV cameraman in New York, Washington or Philadelphia, including fully furnished apartment in beautiful section of Munich. Write: F. Sittl, München-Bogenhausen, Buschingstrasse 45 XII, Germany. Additional information in New York from: Ursula Heemann, 123 East 39 St., New York 16. YU 6-5478.

Journals Available/Wanted

These notices are published as a service to expedite disposal and acquisition of out-of-print Journals. Please write direct to the persons and addresses listed.

Available

Transactions and all issues of the Journal from July 1927 to Dec. 1959. For sale as entire lot only. Henry Roger, Rolab Studios, Sandy Hook, Conn.

Transactions. Ten volumes, Nos. 19 through 34. Write: William C. Kunzmann, 2992 West 14 St., Suite 2, Cleveland 13, Ohio.

Index 1936–1945; Mar.–Sept., Nov., Dec. 1947; Jan., Feb., Sept., Nov., Dec., Index Jan.–June 1948; Jan., Mar. & High-Speed Photography, Apr.-July, Index Jan.–June, Sept.–Dec., Index July–Dec. 1949; Jan.-Oct., Dec., Indexes Jan.-Dec. 1950; Jan.–Apr., June, July, Sept.–Dec., Indexes Jan.–Dec. 1951; Jan.–July, Index Jan.–June 1952; Jan.–Aug., Nov., Dec., Indexes Jan.–Dec. 1953; Jan.–June, Aug.–Dec., Indexes Jan.–Dec. 1954; Jan.–Dec. & Index 1955; Jan.–Dec. & Index 1956; Jan., Mar. 1957; Jan., Apr. 1958. Available as entire lot for $100. Camille Buyse, 1232 Chaussee de Wavre, Auderghem-Brussels 16, Belgium.

Jan. 1936 through Mar. 1957, except Mar. 1942 and Jan. 1945. Send offer to: R. S. Parris, 29 Charles St., Natick, Mass.

Assortment of Journals, from 1937 through 1950. Write: Alan Cook, South Londonderry, Vt.

Complete set of Journals March 1937 through May 1954. Best offer. A. R. Ulmer, 69 Cresskill Ave., Dumont, N. J. DU 4-8656.

Complete set of Journals January 1949 through December 1960, inclusive, including high-speed, special issues, indexes, directories, etc., in excellent condition. For sale as entire lot only. Leslie Helhena, P. O. Box 643, Burbank, Calif.

Complete set of Journals from January 1934 through June 1960. Excellent condition. For sale only as a set. Write: Don Norwood, 1470 San Pasqual St., Pasadena, Calif.

Complete set of Transactions, except Nos. 6 and 9, and all Journals published to date, including indexes. All in good condition. Price $500. Also extra copies of Transactions Nos. 21, 31, 32. W. W. Hennessey, RFD #2, Pound Ridge, N. Y.

Complete set of Journals from May 1937 to June 1954, including special volumes and membership directories, excellent condition; also Mar., May 1934 and July 1935 issues. Write: Harry R. Lubcke, 2443 Creston Way, Hollywood 28, Calif. HO 9-3266.

Jan-Dec. 1950; Jan., Feb., Apr.-Dec. 1951; Jan-Mar. 1952. Also available are vols. 6 and 7 of The Television Society (British) covering the period Jan. 1950 through Sept. 1955. Write: Andrew N. McClellan, 65 Hillside Drive, Toronto 6, Ont., Canada.

Dec. 1946, Feb.-Dec. 1947, 1948–1955 complete. All copies in perfect condition; for sale as entire lot only. Write: Joseph W. MacDonald, 2414 Sullivant Ave., Columbus 4, Ohio.

Jan. 1947 to Dec. 1957 complete and in perfect condition. For sale only as a set. Write: Charles J. Marshall, 2816 Royalston Ave., Kettering 19, Ohio.

Complete set of Journals Jan. 1949 to Dec. 1958. Perfect condition. What offers? Write: J. G. Jackson, 210 Kingsway South, Port Alberni, B. C., Canada.

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FOR SALE: ARRIFLEX 35mm Model IIB with 180° shutter, ARRIFLEX SOUND BLIMP, variable-speed motor, 28mm and 75mm Schneider lenses, 400-ft magazine, 110-v synchronous motor and other accessories—$3,500.00 or good offer. Triumph Films, Inc., Maverick Building, San Antonio 5, Texas.

Wanted

Jan., July, Sept. and Nov. 1949; Jan and Feb. 1950. Century Lighting, Inc. (Mrs. Levine), 521 W. 43 St., New York 36, N.Y.

Feb., Mar., Apr., June 1934. Mrs. Janet Van Duyn, Librarian, CBS Laboratories, 227 High Ridge Rd., Stamford, Conn.

Journals—Bound volumes. Write: S. P. Solow, Consolidated Film Industries, Inc., 959 Seward St., Hollywood.

Transactions 6 and 9 ($15 each offered). W. W. Hennessey, RFD #2, Pound Ridge, N.Y.

Jan. 1938, Jan. 1949. (Many other issues are available for trade.) Dept. of Cinema, Univ. of Southern Calif., University Park, Los Angeles 7. Att: Herbert E. Farmer.

Mar. 1939, May 1940, July, Feb. 1942, July 1949. V. E. Patterson, 2 North 30th St., Phoenix, Ariz.

Résumés / Resumenes / Zusammenfassungen

The Society is grateful to the following authors for supplying translations: R. G. Neuhauser—*French, German;* George T. Keene—*French, Spanish, German;* Leslie P. Dudley—*French, Spanish, German;* B. E. Drimmer, A. D. Solem and H. M. Sternberg—*French, Spanish, German;* Frederick P. Bentham—*French, Spanish, German;* J. S. Myles and J. N. Reid—*French, Spanish, German.* A translation contributed by Alex Quiroga is also gratefully acknowledged.

Caractéristique électro-optique du vidicon et le télécinéma

R. G. Neuhauser [791]

Les courbes de transformation lumière-courant du vidicon ne peuvent pas être prises directement pour prédire la caractéristique électro-optique d'un système de télécinéma. La pratique de règler le signal vidéo de façon que la partie la plus sombre soit au niveau noir, ou bien au "cut-off" du tube de réception, a comme conséquence un changement de la caractéristique électro-optique effective du vidicon. Il est donc nécessaire d'ajouter au signal électrique une correction "gamma" pour reproduire correctement un film. La correction nécessaire est donnée pour obtenir la reproduction correcte du film, en conformité avec les spécifications proposées récemment pour la gamme des densités et caractéristiques électro-optiques du télécinéma. (*Tr. par. F. S. Veith*)

Simulacre de photographie nocturne en utilisant des films couleur inversibles

George T. Keene [795]

On examine à fond les méthodes présentées pour obtenir des effets de photos nocturnes prises pendant le jour, et on explore plusieurs améliorations possibles. Un original reçoit une surexposition de deux ouvertures et en suite est imprimé en utilisant comme patron une copie inversible, pour donner la réduction voulue de l'échelle de tons, moins saturation des couleurs et un effet nocturne plus réaliste. On y explique le compromis entre le réalisme et le ton comprimé. Des vues prises á l'aide de lumière artificielle et du clair de la lune sont aussi brèvement traitées.

Photographie lunaire autostéréoscopique

Leslie P. Dudley [799]

Lorsqu'il sera possible pour les astronefs de se poser doucement sur la lune, on aura besoin d'appareils optiques de grande efficacité pour l'instruction de groupes d'astronavigateurs et pour l'étude de la topographie lunaire. On estime à cet égard que les photographies stéréoscopiques de la surface de la lune qui ne nécessitent pas un dispositif individuel de visée s'avéreront d'une grande valeur. A ce sujet, le mémoire expose dans ses lignes générales le projet de produire de telles photos d'après les données transmises d'un astronef situé dans l'orbite de la lune.

La reproduction cinématique des solutions numériques des problèmes de la hydrodynamique explosive

B. E. Drimmer, A. D. Solem, et H. M. Sternberg [803]

Les problèmes d'explosion et de choc sont résolus au moyen de machines calculatrices à haute vitesse. Le problème est remplacé par un système de points, chaque point possédant les caractéristiques physiques correspondantes à la position du système explosif considéré. Périodiquement les nouvelles positions de tous les points calculés sont simultanément reproduites sur l'écran d'un osciloscope, photographiées et ensuite animées, fournissant une présentation visuelle rapide du mouvement. Un film fournit cette animation, y compris la comparaison correspondante d'un phénomène explosif, enregistré à une vitesse d'un million d'images par seconde au moyen de la caméra Beckman & Whitley Modèle 189.

Equipement de projecteur réversible pour salles de revue

R. A. Bull [806]

Certains avantages d'économie résultent de l'emploi d'un équipement de projection réversible dans les salles de revue de films, commandé à distance depuis la salle même. L'auteur décrit les caractéristiques essentielles de cet équipement.

Equipements de réverbération artificielle pour salles publiques et systèmes au dio

G. R. Crane et G. A. Brookes [809]

Ce mémoire décrit deux nouveaux types d'équipement pour produire une réverbération artificielle. L'un d'eux est utilisé pour augmenter le temps de réverbération utile dans les églises ou autres salles publiques où le temps de réverbération naturelle est en-dessous du niveau désiré. L'autre type est destiné aux studios audio dans le but d'y introduire des effets spéciaux. La réverbération artificielle est produite dans un système-mémoire à débit multiple enregistré magnétiquement. Dans les applications de salles publiques, l'information de réverbération est alimentée à une série de hauts-parleurs dans les murs latéraux qui simulent une série de surfaces réfléchissantes, chaque poste recevant sa propre information réverbérante distincte. Tant dans les applications de salles publiques que dans celles de studios audio, le temps de réverbération et la réponse de fréquence de réverbération peuvent être régulés sur une grande étendue.

Types de console de commande d'éclairage employé dans les studios de télévision anglais

Frederick P. Bentham [814]

La commande de l'éclairage a assumé une grande importance en Grande-Bretagne, à la fois comme un instrument d'expression dramatique et pour le contrôle de la qualité de l'image. Le contrôleur de l'éclairage (Directeur) actionne souvent lui-même la commande sans l'intervention d'un électricien. La qualité de la mémoire automatique dérivée de l'inertie des systèmes de gradateurs électromécaniques a simplifié la construction de ces commandes, et en conséquence, beaucoup d'utilisateurs en Grande-Bretagne, sont opposés à adopter les genres de gradateurs complètement électriques tels que le thyratron et le SCR qui suggèrent des résaux préréglés multiples.

Hétérodyne de synchronisation à transistrons

J. S. Myles et J. N. Reid [822]

C'est la description d'un générateur de synchronisation qui n'emploie que des semiconducteurs comme dispositifs d'amplification ou de branchement. Les sorties normales établies par l'EIA sont formé par une méthode inédite de sélectionner les impulsions à partir d'un unique train d'impulsions, le déclenchement et la durée de chaque portion de ces formes d'onde ayant une relation de temps précise avec le train d'impulsions dont ces dernières émanent.

L'article donne des exemples du plan du circuit et décrit certains éléments électriques et mécaniques.

Les méthodes de réalisation décrites ont été utilisées dans l'établissement d'un générateur de synchronisation auquel a été assigné le numéro de modèle R20861A.

Características del traslado de luz del vidicon y la reproduccíon de películas

R. G. Neuhauser [791]

Las características del traslado de luz del vidicon no se pueden usar directamente para predeterminar las características del traslado de luz de películas en un sistema de video. La práctica de arrestar la excursión de la parte mas oscura de una señal de video al nivel negro -o sea de cero luminosidad del kinescopio- cambia la característica efectiva del traslado de luz del vidicon. Para reproducir correctamente películas en television, la gama de la señal de video se debe someter a una corrección adicional. Se describe la índole de corrección necesaria para la reproducción correcta de películas. Esta corrección esta de acuerdo con las nuevas especificaciónes propuestas para la escala de densidades y las démas características de las películas para televisión. (*Tr. de Alex Quiroga*)

Simulacro de fotografia nocturna usando peliculas reversibles en color

George T. Keene [795]

Se examinan rigurosamente los métodos actuales de obtener un efecto de noche en la fotografía con luz solar y, al mismo tiempo, se sondea un número probable de mejoras. Aquel original objeto de una subexposición equivalente a dos aberturas de diafragma mayores, e impreso mediante un patrón de imprimir, ha demostrado proporcionar una reducción apetecible en la escala de tono, menor saturación de color y un efecto nocturno más real. Explica la necesaria transigencia entre el realismo y la compresión de tono. Discute la fotografía de escenas nocturnas tomadas con luz artificial o de la luna.

Fotografía lunar autoestereoscópica

Leslie P. Dudley [799]

Cuando los astronautas puedan efectuar aterrizajes suaves en la luna, se van a necesitar aparatos ópticos eficaces para el aleccionamiento de grupos y para la educación sobre topografía lunar. Se estima que resultarán de un gran valor en este sentido, las fotos estereoscópicas de la superficie lunar, que para visionarlas no requieran un aparato visor individual. De acuerdo con esto, el artículo esboza una proposición para la producción de este tipo de vistas obtenidas con los datos transmitidos desde una astronave en órbita dentro del espacio.

La representación cinemática de las soluciones de problemas de explosiones en la hidrodinámica

B. E. Drimmer, A. D. Solem, y H. M. Sternberg [803]

Máquinas calculadoras de alta velocidad son usadas para resolver problemas de explosiones y de choques. Cada problema es reemplazado por una red de puntos en la que cada punto tiene asignadas las caracteristicas fisicas del sistema explosivo que se considera. Periódicamente, las nuevas posiciones de todos los puntos calculados son presentadas como puntos movibles sobre una pantalla osciloscopica y fotografiadas. Mas tarde, provistas de animación, en forma de película, una sucesión de estas posiciones suministran una rapída visualización del movimiento completo. Una película así preparada incluye una comparación con una película del correspondiente fenómeno explosivo actual, la cuál fué tomada con una cámara Beckman y Wnitley, Model 189, de un millón de exposiciones por segundo.

Equipos de proyector reversible para cuartos de revisión

R. A. Bull [806]

Ciertas ventajas económicas se obtienen con el uso de equipos de proyección reversible en los cuartos de revisión, controlados remotamente desde el local del auditorio. Se describen las características esenciales de dichos equipos.

Facilidades de reverberación artificial para locales de auditorios y sistemas de audio

G. R. Crane y G. A. Brookes [809]

Se comentan dos nuevos equipos para producir reverberación artificial. Se emplea uno para aumentar el período efectivo de reverberación en iglesias y otros locales públicos en los que el período de reverberación natural está por debajo del nivel deseado. El otro es para usarse en aplicaciones de estudios de audio con el objeto de introducir efectos especiales. La reverberación artificial se produce en un sistema memorizador de grabación magnética y salidas múltiples. Cuando se usa en locales de auditorios, la información de reverberación es alimentada a una serie de altavoces colocados en las paredes, los que simulan un conjunto de superficies reflectoras, recibiendo cada aparato su propia información reverberante distintiva. Tanto en las aplicaciones para locales de auditorios como en estudios, el período de reverberación y la respuesta de frecuencia de la reverberación pueden regularse en extensa amplitud.

Diseño de las consoles para control del alumbrado en los estudios británicos de televisión

Frederick P. Bentham [814]

En la Gran Bretaña el control de alumbrado ha adquirido gran importancia tanto como instrumento de expresión dramática como para controlar la calidad de la visión. El luminotécnico (director) generalmente opera los mandos directamente sin la intervención de un electricista. La calidad de memoria automática derivada de la inercia de los sistemas de amortiguación de luz electro-mecánicos ha simplificado el diseño de estos mandos y, en consecuencia, ha obligado a muchos usuarios en la Gran Bretaña a mostrarse rehacios a la adoptación de formas de amortiguadoras enteramente eléctricas tales como el tiratrón y SCR lo que sugiere redes múltiples preajustadas.

Generador de señales de sincronización a transistores

J. S. Myles et J. N. Reid [822]

Se describe un generador de sincronización que emplea unicamente semiconductores como elementos de amplificación o desviación. Las distintas potencias de slida standard de la EIA se forman mediante un metodo original de selección de pulsaciones procedentes de un solo tren de pulsaciones, y el comienzo y la duración de cada porcion de estas ondas tienen una relación precisa de tiempo con el tren de pulsaciones que las origina.

Se dan ejemplos del diseño del circuito y se examinan algunas sus caracteristicas electricas y mecanicas.

Los metodos de diseño descritos se han aplicado a un generador de sincronización al que se le ha asignado como numero de tipo el R20861A.

Uebertragungskennlinie und Filmwiedergabefaehigkeit der Vidikon Bildaufnahmeroehre

R. G. Neuhauser [791]

Die Uebertragungskennlinie des Vidikons kann nicht fuer die direkte Vorausbestimmung der Uebertragungseigenschaften eines Fernseh-Filmsystems verwendet werden. Die in der Praxis uebliche Methode die dunkelsten Bildpartien des Videosignals als Schwarzpegel zu verwenden, veraendert die effektive Uebertragungskennlinie des Vidikons. Korrekte Fernseh-Filmwiedergabe verlangt deshalb zusaetzliche Gammaregelung des elektrischen Signals. Die vorliegende Arbeit beschreibt die Art der benoetigten Regelung zur korrekten Fernseh-Filmwiedergabe, die den neurdings vorgeschlagenen Bestimmungen fuer Kontrastbereich und Uebertragungskennlinie entspricht. (*Ub. von Hans Popp*)

Vorgetäuschte Nachtphotographie mit Farb-Umkehrfilm

George T. Keene [795]

Die allgemein üblichen Methoden Nachteffekte bei Tageslicht-Photographien zu erzielen, sind kritisch überholt worden, und man hat eine Reihe von Möglichkeiten entdeckt, diese Methoden zu verbessern. Ein überbelichtetes Originalnegativ (2 Blenden Überbelichtung), mit Hilfe eines Zwischen-positivs kopiert, zeigt eine erwünschte Verminderung der Farbtonskala, mattere Farben und einen realistischeren Nachteffekt. Der notwendige Kompromiss zwischen Realismus und Zusammendrängung der Farbtöne ist erklärt. Nachtszenen, mit Hilfe von Kunstlicht und Mondlicht aufgenommen, werden kurz besprochen.

Autostereoscopische Mondphotographie

Leslie P. Dudley [799]

Wenn sanfte, bemannte Landungen auf dem Mond praktisch durchführbar werden, dann werden wirksame visuelle Hilfsmittel zur Gruppeninstruktion und für topographische und unterrichtende Zwecke benötigt werden. Man

ist der Ansicht, dass sich stereoskopische Photographien der Mondoberfläche, die den Gebrauch von individuellen Sehinstrumenten nicht erfordern, als wertvoll in dieser Beziehung erwiesen würden. Die dementsprechende Abhandlung skizziert einen Vorschlag zur Herstellung solcher Bilder nach Information die von einem orbital gelenkten Weltraumvehikel übermittelt wurde.

Die Kinematographische Darstellung numerischer Lösungen von Problemen der Explosions-Hydrodynamik

B. E. Drimmer, A. D. Solem, und H. M. Sternberg [803]

Man benützt elektronische Rechenmaschinen um Explosions- und Stossprobleme zu losen. Jedes Problem wird als Gittersystem betrachtet, in dem jeder Punkt die physikalischen Eigenschaften des entsprechenden Ortes in dem Explosionssytem hat. Periodisch werden die neuen Lagen aller berechneten Punkte gleichzeitig als Bildpunkte auf einem Oszilloskop gezeigt, photographiert und später in schneller Folge reproduziert, wodurch man eine visuelle Darstellung der Bewegung erzeugt. Ein Film zeigt diese Folge und vergleicht sie mit einer entsprechenden Explosion, die mit einer Geschwindigkeit von einer Million Bildern pro Sekunde mit Hilfe eines Beckman and Whitley Model 189 Apparates photographiert wurde.

Projektor-Ausrüstung mit Fern-Umschaltung für Vorführ-Räume

R. A. Bull [806]

Bei der Verwendung von Projektions-Geräten mit Fern-Umschaltung, die vom Zuschauerraum aus gesteuert werden kann, ergeben sich einige wirtschaftliche Vorteile. Die wichtigsten Konstruktions-merkmale dieser Anlage werden beschrieben.

Anlagen zur Erzeugung künstlichen Nachhalls in Grossräumen und bei Audio-Systemen

G. R. Crane und G. A. Brookes [809]

Es werden zwei neue Anlagen zur Erzeugung künstlichen Nachhalls besprochen. Die eine wird zur Erhöhung der wirksamen Nachhall-Zeit in Kirchen oder anderen Grossräumen benützt, in denen die natürliche Nachhall-Zeit unter dem gewünschten Pegel liegt. Die andere Anlage ist zur Verwendung in Ton-Studios gedacht, und dient zur Schaffung besonderer Effekte. Der künstliche Nachhall wird in einem Vielfach-Gedächtnis-System auf Magnet-Aufnahmebasis erzeugt. Bei der Verwendung in Grossräumen gelangt der so geschaffene Nachhall in eine Wandsprecher-Anlage, die eine Reihe von Reflektions-Oberflächen nachbilden, bei der jeder Sprecher seinen eigenen Nachhall-Impuls erhält. Die Nachhall-Zeit und die Nachhall-Frequenz-Leistung können innerhalb eines weiten Bereichs gesteuert werden, und zwar bei der Grossraum-Anwendung wie auch bei der Verwendung im Aufnahme-Atelier.

Konstruktion von Beleuchtungs-Schaltanlagen bei den Fernseh-Ateliers in Gross-Britannien

Frederick P. Bentham [814]

In Grossbritannien hat die Beleuchtungssteuerung als Mittel des dramatischen Ausdrucks und für Überwachung der Bildqualität grosse Bedeutung erlangt. Die die Beleuchtung kontrollierende Person (Regisseur) bedient die Regelorgane häufig selbst ohne Inanspruchnahme eines Elektrikers. Die Güte des automatischen Erinnerungsvermögens, die sich aus der Trägheit des elektromechanischen Helligkeitssteuersystems ergibt, hat die Konstruktion dieser Regelorgane vereinfacht, so dass viele Benützer in England neuerdings ungern rein elektrische Helligkeitssteuergeräte, wie z.B. Thyratron und SCR verwenden, die viele vorher eingestellte Stromkreise erfordern.

Transistor Synchronisierungs Signal Generator

J. S. Myles und J. N. Reid [822]

Folgend ist ein Synchronisierungs Signal Generator beschrieben der als Verstaerkung oder Schaltelement eine Halbleiter benuezt. Die normalen Wellenformen der E I A sind durch eine einzelne Impulsfolge bei besonderer Impulswahl erzeugt.

Der Anfang sowie die Zeitdauer von jedem Teil der Wellenformen haben ein bestimmtes Zeitverhaeltnis gegenueber dem originalen Impuls.

Verschiedene Schaltplanentwuerfe sind gegeben und einzelne electrische sowie mechanische Vorteile diskutiert.

Die Entwurfsmethoden, welche in dem Synchronisierungs Signal Generator gebraucht wurden, sind mit der No. R 20861A bezeichnet.

Ed. Note: Titles and abstracts of all papers published in the *Journal* are published in French, Spanish and German. This department (Résumés/Resumenes/Zusammenfassungen) was set up in recognition of the growth in the Society's overseas membership, and first appeared as a regular feature of the *Journal* in the January 1961 issue. Comments and suggestions are invited on the quality and possible improvement of the translations. Because of the prohibitive cost of commercial translations, volunteer help is needed, and such assistance will represent an important contribution to the Society. Contributors will, of course, be given full acknowledgment in the *Journal*.

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News Columns

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Meeting Calendar

AIEE, Fall General Meeting, Oct. 15–20, Statler-Hilton Hotel, Detroit.

ASCE, Annual Meeting, Oct. 16–20, Hotel Statler, New York.

Optical Society of America, Fall Meeting, Oct. 18–20, Biltmore Hotel, Los Angeles.

8mm Sound Film and Education, Nov. 8–10, Teachers College, Columbia Univ., New York.

Acoustical Society of America, Meeting, Nov. 9–11, Cincinnati and Dayton, Ohio.

Air Force Office of Scientific Research, Second International Conference on the Exploding Wire Phenomenon, Nov. 14–15, Boston, Mass.

American Physical Society, Nov. 24, 25, Chicago.

ASME, Annual Meeting, Nov. 26–Dec. 1, Hotel Statler, New York.

Society of Reproduction Engineers, Visual Communications Congress, Dec. 1–4, Hotel Biltmore, Los Angeles.

AICE, Annual Meeting, Dec. 3–7, Hotel Commodore, New York.

American Association for the Advancement of Science, Annual National Meeting, Dec. 26–31, Denver Hilton, Brown Palace, Cosmopolitan, Shirley Savoy Hotels, Denver, Colo.

Electronic Industries Association, Eighth National Symposium on Reliability and Quality Control, Jan. 9–11, 1962, Statler-Hilton Hotel, Washington, D. C.

ASME, Symposium on Thermophysical Properties, Jan. 22–26, 1962, Princeton Univ., Princeton, N. J.

American Physical Society, Jan. 24–27, 1962, New York.

AIEE, Winter General Meeting, Jan. 28–Feb. 2, 1962, Hotel Statler, New York.

Institute of the Aerospace Sciences, Annual National Meeting, Jan. 29–31, 1962, Hotel Astor, New York.

Society of the Plastics Engineers, Annual Technical Conference, Jan. 30–Feb. 2, 1962, Penn-Sheraton Hotel, Pittsburgh, Pa.

AICE, National Meeting, Feb. 4–7, 1962, Statler-Hilton, Los Angeles.

American Society of Photogrammetry, Annual Convention, Mar. 11–17, 1962, Washington, D. C.

American Chemical Society, National Meeting, Mar. 20–29, 1962, Washington, D. C.

IRE International Convention, Mar. 26–29, 1962, New York.

91st Semiannual Convention of the SMPTE, Apr. 29–May 4, 1962, Ambassador Hotel, Los Angeles.

Electrochemical Society, Annual Meeting, May 6–10, 1962, Statler-Hilton Hotel, Los Angeles.

SPSE Annual Conference, May 7–11, 1962, Somerset Hotel, Boston, Mass.

IRE, National Aerospace Electronics Conference, May 14–16, 1962, Dayton, Ohio.

AIEE, ARS, IAS, IRE, ISA, National Telemetering Conference, May 23–25, 1962, Sheraton-Park Hotel, Washington, D. C.

6th International Congress on High-Speed Photography, Sept. 17–22, 1962, Hotel Kurhaus, Scheveningen, Netherlands.

92nd Semiannual Convention of the SMPTE, Oct. 21–26, 1962, Drake Hotel, Chicago.

93rd Semiannual Convention of the SMPTE, Apr. 21–26, 1963, Traymore, Hotel, Atlantic City, N. J.

94th Semiannual Convention of the SMPTE, Oct. 13–18, 1963, Somerset Hotel, Boston.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters and of the Committee Chairmen and Members were published in the April 1961 Journal.

sustaining members

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- Dissemination of scientific knowledge by publication.

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